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The Brundtland Challenge and the Cost of Inaction

The Brundtland Challenge and the Cost of Inaction

Edited by
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Foreword

This is a report on two workshops on environmental issues held in early 1988. The first, at Hull, Quebec, January 15 to 17, entitled "The Cost of Inaction" was sponsored by the Royal Society of Canada and the Institute for Research on Public Policy. The second, "The Brundtland Challenge," at the University of Waterloo, March 4 and 5, was sponsored by the University of Waterloo, the Institute for Research on Public Policy, Environment Canada and the Royal Society. Both were generously supported by grants from a number of sources acknowledged, with the thanks of all of us associated with these meetings, in Appendix A.

These two workshops brought together a number of people with long experience in environmental issues, as well as a number of well-known social scientists and senior resource economists, from government, academic circles, and private organizations. Attendance was by invitation; attendees are listed in Appendix B.

They were held at a time of considerable ferment, one which sees the development of major initiatives in the field of environmental policy both nationally and internationally.

In 1986 the International Council of Scientific Unions (ICSU) adopted a program of unprecedented size and complexity, the International Geosphere-Biosphere Program (IGBP), a study of global

change. The Royal Society of Canada has led the planning and organization of the Canadian component of the program.

At the same time the Royal Society and the Institute have been exploring an agenda for parallel programs in the humanities and social sciences. These workshops formed part of that exploration. The International Federation of Institutes for Advanced Study (IFIAS) has moved to establish an international program on the theme of human response to global change. The International Institute of Applied Systems Analysis (IIASA) has launched a Sustainable Development Program.

In the past year the precedent-breaking report of the World Commission on Environment and Development, "Our Common Future," has attracted wide attention, and an exciting Canadian response has resulted in the report of the National Task Force on Environment and Economy.

Recently, the Institute for Research on Public Policy (IRPP) has also launched a new program on Environment and Sustainable Development. It will provide credible and independent policy and program analysis on environmental issues both in Canada and internationally.

Each of the two workshops was organized into plenary sessions at which a range of overview papers were presented, and into three working groups which discussed allotted topics and were reported to the plenaries by rapporteurs (listed in Appendix C). The editors thank the rapporteurs and the organizers of the Waterloo meeting, Tony Friend, Rob Hoffman, and David Rapport, for their very useful notes and suggestions.

The stated main objective of the Hull workshop was to discuss the cost of inaction on environmental issues. General themes were set as how do we measure it, getting it on the political and public agenda, and what can and should be done, and by whom. Waterloo, with a somewhat more ambitious scope, planned to build on the Hull findings and, in particular, discuss the implications for Canada of the Brundtland report. The suggested underlying themes were the adequacy of the prevailing economic model, the institutional barriers to implementing the Brundtland agenda, and the information and research required to support sustainable development.

At each meeting, however, participants refused to be constrained by the agenda. Many of them were deeply concerned with the lack of progress on environmental issues in general, and saw this as an opportunity to explore the question in a more fundamental way. There was, of course, a good deal of talk about the cost of inaction, economic analyses and models, and information needs. But there was more about the nature of the environmental problem, the reasons for the failure of policy and institutions to respond, how the topic of

environment and sustainable development might be moved to the top of the political agenda, and specifically what should be done now to realize that goal.

In response to calls for action a resolution was accepted at Hull (Appendix D), and a number of recommendations were made at both workshops which will be noted later. It is our hope that this brief record of the extensive discussion of these meetings will help to stimulate action now urgently required in this difficult but critical domain.

A.R. Dobell
President
Institute for Research on Public Policy

Digby J. McLaren
President
Royal Society of Canada

Avant-propos

Il s'agit du compte rendu des travaux de deux ateliers portant sur les problèmes de l'environnement qui se sont tenus au début de l'année 88. Le premier, qui devait examiner "Les coûts du laissez-faire", était parrainé par la Société royale du Canada et par l'IRP; il a eu lieu à Hull, Québec, du 15 au 17 janvier. Le second, intitulé "Le défi de Brundtland", s'est tenu à l'Université de Waterloo les 4 et 5 mars. Il était parrainé par l'Université de Waterloo, l'IRP, Environnement Canada et la Société royale. Ces deux rencontres ont bénéficié de l'aide financière de plusieurs organismes et institutions dont les noms figurent, avec les remerciements de tous ceux qui ont pris part, à l'annexe A de ce document.

Ces ateliers réunissaient un certain nombre de spécialistes des questions d'environnement et des sciences sociales, ainsi que des économistes renommés en matière de ressources. Toutes ces personnes avaient été invitées et provenaient de différents horizons: gouvernement, universités, secteur privé. Leur liste est reproduite à l'annexe B.

Les deux rencontres ont eu lieu à un moment crucial, alors que des initiatives politiques majeures sont en train de se réaliser dans le domaine de l'environnement, tant au niveau national que sur la scène internationale.

En 1986, le Conseil international des associations scientifiques (International Council of Scientific Unions - ACSU) adoptait un programme d'une ampleur et d'une complexité sans précédent, le Programme international sur la géosphère et la biosphère, chargé d'entreprendre une étude sur les changements globaux. La Société royale se voyait attribuer la responsabilité de la planification et de l'organisation de la contribution canadienne au programme.

La Société royale et l'Institut ont, en outre et de leur côté, étudié la possibilité d'organiser des programmes similaires dans le domaine des humanités et dans celui des sciences sociales. Les deux ateliers dont il est question ici s'inscrivent dans ce contexte de recherche. La Fédération internationale des instituts pour les études avancées (IFIAS) a également décidé de créer un programme international sur le thème de la réponse humaine aux changements globaux, et l'Institut international d'analyse des systémes appliqués (IIASA) a lancé un Programme de développement durable.

Au cours de l'année dernière, le rapport innovateur de la Commission mondiale sur l'environnement et le développement a fait grand bruit et le Canada, pour sa part, y a répondu d'une manière intéressante dans le rapport du Groupe d'étude national sur l'environnement et l'économie.

L'IRP vient aussi de créer son propre programme d'étude de l'environnement et du développement durable. Ce programme aura pour objectif de fournir des analyses solides et indépendantes sur les questions d'environnement intéressant le Canada et le reste du monde.

Les deux ateliers qui nous occupent ici comportaient chacun des sessions plénières, au cours desquelles étaient présentéés des études d'ordre général, et ils se divisaient par ailleurs en trois groupes de travail pour la discussion des questions plus spécifiques. Les travaux de ces groupes faisaient l'objet de comptes rendus qui devaient être soumis aux sessions plénières par des rapporteurs désignés (voir annexe C). Les éditeurs sont heureux de remercier les rapporteurs ainsi que les organisateurs du colloque de Waterloo, Tony Friend, Rob Hoffman et David Rapport, pour leurs remarques et suggestions extrêmement utiles.

L'atelier de Hull avait pour objectif principal d'examiner les coûts de la politique du laissez-faire en matière d'environnement. Les thèmes à étudier portaient sur: la manière dont ces coûts peuvent être évalués; comment leur question peut être mise à l'ordre du jour des débats politiques et publics; ce qui peut et doit être fait et par qui. La perspective adoptée par Waterloo était, en quelque sorte, plus ambitieuse. Il s'agissait de compléter les travaux de Hull en s'attachant plus particulièrement à l'examen des implications que le rapport Brundtland pouvait avoir pour le Canada. Les thèmes sous-

jacents proposés portaient sur: la pertinence du modèle éeonomique en cours; les obstacles institutionnels à la mise en oeuvre du programme de Brundtland; l'information et la recherche nécessaires à la poursuite du développement durable.

Les participants à ces rencontres ont toutefois refusé de se laisser limiter par les contraintes de l'ordre du jour. Beaucoup d'entre eux ont exprimé leur inquiétude devant l'absence de progrès dans le domaine de l'environnement et se sont autorisés de cette carence pour se donner le droit d'examiner l'ensemble du problème d'une manière plus approfondie. Il a évidemment été beaucoup question des coûts du laissez-faire, des analyses et des modèles économiques et des besoins d'information en ce domaine. Mais on a également discuté de la nature du problème de l'environnement, de l'absence de mesures politiques et de l'apathie des institutions, de la façon dont les questions d'environnement et de développement durable pourraient être inscrites en priorité à l'ordre du jour des débats politiques, et plus particulièrement de ce qui devrait être fait immédiatement pour réaliser cet objectif.

En réponse aux voeux exprimés pour que l'on prenne des mesures concrètes, l'atelier de Hull a formulé une résolution (annexe D) et un certain nombre de recommandations ont été adoptées au cours des deux ateliers; il en sera question ultérieurement.

Nous espérons que cet aperçu sur les longs débats qui se sont déroulés à l'occasion de ces deux rencontres contribuera à stimuler l'esprit d'initiative plus que jamais nécessaire dans ce domaine difficile mais essentiel.

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Editor's Introduction

Alex Davidson

As noted in the Foreword, participants were not constrained by the formal workshop agendas and ranged widely over the environmental issue. At the first workshop many dealt with environment and development, pointing out that the costs of inaction are in part economic costs and reflect themselves in a reduced potential for development. Accordingly, this report does not attempt to follow the agendas but reports on the discussions under four main headings: Summary and List of Recommendations, The Nature of the Environmental Issue, The Apparent Failure of Decision-Making Processes and Institutions – Why Have We Not Done Better, and What Needs To Be Done – an agenda for action.

Summary and List of Recommendations

The Brundtland report and the report of the National Task Force on Environment and Development, and the deep concern of the public evidenced by the public opinion polls, has put environment strongly on the political agenda in Canada. Participants at the workshops, sensing this is a critical time for more action, struggled to make use of this opportunity for employing collective experience to determine what should be done.

The Hull workshop considered whether better measurements, putting dollar values on the costs of environmental degradation, would provide a tool to aid progress in making environmental issues more relevant to decision making. Most participants were not inclined to accept that improved measurements of costs, improved economic analysis, was in itself a key to progress. Better analysis tools would develop, however, when environment and economy are considered together.

In national security, education, even forestry, decisions are often made without precise and accurate economic analysis. Why not in environment? As Jim MacNeill pointed out at Hull, we are not really here to talk about the costs of inaction, that is, inaction on spillovers, but about the costs of action: development action driven by private decisions and public policies on development. Looked at that way, he said, the issue requires a new framework for decision analysis – that is the Brundtland formulation.

An underlying debate and issue was whether in order to make progress, or to ward off disaster, our value system or ethics must be radically changed, or whether progress can be made working within the prevailing system of values and power structure – recognizing that stewardship is a part of our present values. Or must we be virtually "reborn" and start off on different premises? That was, of course, not resolved. But the consensus seemed to be that the Brundtland formula is an approach which builds on the present situation, and that offers the hope of change and progress. Let's get on with it. Eventually the values and myths held now by a minority of environmentalists and conservationists may become the predominant value system.

A major and central issue identified over and over is that environment is not now central in decision making; it is marginalized, an add-on, often segmented. A provincial premier can announce at the same time a major environmental protection program of water clean-up and a new agricultural drainage program without seeing any possible connections between the two.

Perhaps this is so because the issue is relatively new in the history of decision making on public issues. In any event, environment must be brought into the centre before it is too late and the sustainable development approach offers the possibility of doing that. Then economic, social and ethical principles can be brought to bear more effectively, and evidence from the understanding of natural systems can be brought into political and industrial decision making.

Participants did not present themselves as prophets crying doom in the wilderness. Certainly the issue is serious, they said, but there is still time to act, and the lines of action needed to bring environment into the mainstream are clearer than ever. And if all the talk were

boiled down to one proposition it was this: implement the National Task Force report.

Many individual recommendations were made at both workshops and a resolution was accepted at Hull (Appendix D). It might be useful to list some of the recommendations to suggest the fertility of ideas:

1. Create more opportunities for natural scientists and social scientists to work together; bring them together to work on sustainable development.
2. Bring together like-minded countries: Canada, Norway, Sweden, Austria.
3. Greatly increase public involvement and grass roots participation, and decentralize decision making where possible.
4. Require a special section on environmental considerations in Cabinet documents.
5. Make the Department of Finance and Treasury Board responsible for environmental analysis of programs and projects for Cabinet.
6. Turn the Economic Council into a Council for Environment and Sustainable Development.
7. Promote more joint work on sustainable development by independent institutions like the IRPP and the Royal Society.
8. Produce new, periodic, independent State of the Environment reports.
9. Produce a new system of national accounts.
10. Expand research and study of environment-economy linkages, e.g., in agriculture, energy, steel, chemicals.
11. Ensure that our aid program is effectively led by environmental considerations.
12. Appoint an independent environmental ombudsman or a parliamentary commission which would gather and publish information and act as a watchdog on progress on sustainable development.
13. Appoint a new parliamentary committee specifically for sustainable development issues.
14. Plan for a major national conference on sustainable development in 1990. There has not been a major national resources policy conference since the hallmark Resources for Tomorrow in 1961. It is time for new directions.

15. Work to implement the recommendations of the Task Force on Environment and Economy.

The last recommendation on the list deserves special mention, for it was an important topic of discussion, and several groups reported that they considered the recommendations of the Task Force as a major breakthrough. One group at Waterloo stated that in particular it endorsed the round-table process recommended in their report.

Another group, asked for recommendations, responded that we should build on the Brundtland report and the Task Force report rather than issue yet another set of recommendations. Action on the Task Force recommendations, it was generally agreed, is one of the best things that can be done at this stage.

The precedent-breaking Task Force work on the implementation of Brundtland, involving government, industry and NGO representatives, puts Canada in a leading position on this issue. It is possible that Canada can make a major contribution by world leadership on sustainable development, and participants saw exciting possibilities in a leading role for Canada.

The Nature of the Environmental Issue

The Current Picture

Some participants evidently felt it necessary to again discuss the nature of the environmental problem, not to preach doom but to better understand the basis for action to meet it.

It is now almost a decade and a half since the Stockholm Conference. As pointed out by Fred Roots in opening the second workshop, in that time the population of some of the poorest countries has doubled, and hundreds of thousands of square kilometres of land have become eroded and non-productive. There are major changes in the world's atmosphere. With an enormous advance in scientific knowledge it has become apparent that the earth is an organism subject to biological forces, and its very health is subject to change in natural systems.

The variety, intensity and geographical spread of environmental change caused by man is accelerating. This is a new problem in the history of the world, at least new in scale and seriousness. We are losing ground on many fronts – deserts, forests, ozone layer, acidification, man-made climate change. Clearly, environmental degradation at an unprecedented scale world wide is reducing the potential for development.

The Nature of Natural Systems

David Peat said that natural systems are infinitely subtle and complex and, accordingly, related problems are subject to entanglement and entrainment. Such systems may be beyond simple prediction and control.

Rod Dobell emphasized that the world of nature is non-linear, with major uncertainties, much of it perhaps almost unknowable.

Others agreed that natural systems are complex and difficult to predict. We are often dealing with slow, subtle, cumulative effects, some of which may be irreversible, and may result in unwanted changes or surprises. There is, for example, slow and irreversible loss of soil productivity; loss of species is rampant. Natural systems are simplifying under exploitative pressures, resulting in lowered health and resilience.

Douglas Wright said that the natural systems we observe are not only complex but even counterintuitive; there is a prospect for non-linearities and discontinuities, and recently scientists have become more concerned about irreversible changes.

The recognition of the systems approach, the characteristics of uncertainty and risk, the phenomena of discontinuity and non-equilibrium states, are inherent factors in learning to live with a large grey area in identifying cause and effect.

There is no doubt many of those participating showed a deep concern that the environmental issue is indeed a serious one, not just affecting the quality of life and life expectancies, but the long term viability of the natural life support systems themselves. Some see the prospect of a sick natural world, an impoverished and deteriorating world, possibly subject to collapse and failure, and out of our control. At best, the choices for our grandchildren, on which their chances for a good life depend, are being curtailed or foreclosed.

Kenneth Boulding pointed out the pervasive effect of man. We have to worry about the planet, he said, when there are more species of nuts and bolts than there are of birds. He said there is no equilibrium in either man-made systems or natural systems. Sustainability is inherently unpredictable; systems are subject to disaster. Our system results in too much pollution and a decrease in renewable natural resources. The accelerated rise in the capacity to produce artifacts has come up against the finite supply of the earth's materials and energy. The equilibrium model, where supply equals demand, is an artifact of the human mind.

It was agreed several times that if we delay action while awaiting scientific certainty or more precise measurements of the costs and benefits, then we run the risk of immense and uncertain costs.

Poverty and the Environment

The problem of world poverty and its relation to environment was an important area of discussion. The root problem, world wide, is in good part about poverty and the distribution of wealth. Poverty results in environmental degradation, and environmental degradation fosters poverty.

There is a duality in the real world, said Rod Dobell, the rich and the poor. The rich may value wilderness and a clean environment, but the poor are forced to turn to exploitation.

David Peat argued that poor people cut down the forests in the Third World because they have no alternative. The issues of health, environment, economic progress, social change and global politics cannot be separated. And technologies which have caused many of our environmental problems are moving faster than ever.

The related problems of famine, environmental refugees, dislocation of populations, all associated with environmental degradation, were the main focus of one group session at Hull.

It was suggested that the acceptance of the seriousness of the issue, by politicians and the public, may be blunted by the fact that environmentalists have too often cried wolf in the past. The oil crisis, the water crisis, failed to materialize when and as predicted. In response it was said that the present situation is of a different order.

Some Positive Views

Some tried to be more positive in the face of this gloomy picture. There have been positive achievements since Stockholm. As a result of mainly react and cure policies, cleaner air and cleaner water has been attained in many areas. But these successes are relatively small in the broader picture and are confined to the developed world; and all the world, both the developed and the Third World, is faced with the degradation of the world's commons.

The population explosion represents a very real stress to the global environment, said Lars Osberg, but it is amenable to social processes; higher levels of female education, greater participation in the paid labour force, and higher female earnings, do result in reduced population growth in poor countries. He said that a careful analysis of the processes which reduce environmental stress is likely to produce more benefits than cataclysmic proclamations of impending doom.

The participants were prepared to accept that there is a difficult and deepening environmental crisis. But they were more interested and determined in discussing the reasons for failure to act better on it, in the face of at least two decades of experience, and in what should be done. Let us understand the issue and act on it before it is too late.

The Apparent Failure of Decision-making Processes and Institutions – why have we not done better?

Quantifying the Costs

Charles Caccia was one of the promoters of the first workshop, and suggested the topic "The Cost of Inaction." As a former minister, he had found himself frustrated by the lack of money values on environmental degradation from which to argue for action. In a short paper he argued that if we knew the costs of inaction on environmental problems, could measure and quantify them, we would have an important tool to use in decisions on environmental action. We still do not know how to quantify the damage to the environment and to the economy in the long run, he said. This raised for the workshop the question of the use of economic analyses in environmental decision making.

The Complexity of Environment-Economy Interactions

The difficulties of measuring and putting money values on environmental degradation were tackled by many speakers. Rod Dobell pointed out that the market fails to put prices on environmental goods and services because in the main they are not marketed. In the global commons there is no system of property rights, for example, for the breeding stock. We have property rights in harvesting but no property rights in the regenerative capacity, and the loss of regenerative capacity is the loss of species. Where there is no property right, there is no constituency, no one to set the price. Resource exploitation and depletion advance faster than investments to maintain the capital stock. As pointed out earlier, environmental problems are non-linear and long term. Is it feasible at all, he asked, to put prices or precise values on environmental resources?

Tom Crocker said that economists, like anyone else, are much subject to prior beliefs and that, of course, conditions their analyses. He discussed the use of benefit cost analyses at some length. Although it will not produce answers, its purpose is to provide information to help recognize trade-offs. He defended the potential usefulness of economic analysis in environmental decisions. Economic analysis can be useful in putting information in a form relevant for policy analysis, even including information from natural systems research. But his experience is that natural scientists are not good at providing that kind of input for they put too much emphasis on precision. Economists and natural scientists need a better common understanding of the information needs for analyses. He discounted the value of economic analysis in longer-term issues, saying that economic predictions are not much good beyond five years.

Economists can put some more numbers on environmental costs, but many measures of value must be defined outside of economics.

David Peat questioned whether we can count the costs and mathematically describe the kind of systems we are dealing with. The environment may be unpredictable, non-linear and therefore beyond fixed prediction and control. Certain systems may be too complicated to be quantified and we may never gather sufficient data. The traditional approaches of analysis, prediction, and control may not work in this area.

Evaluation of the environmental bequest in money terms is difficult, and also unnecessary, Lars Osberg pointed out, if we recognize it as fundamentally the maintenance of the national heritage.

Many others commented on the measurement of costs so that they might be included in economic analysis. The complexity of natural systems places limits on what is knowable, it was said. It is difficult indeed to attach values to future events.

Limits to Present Tools/Methods

Ann Whyte noted in her group report that some benign economists in her group argued that we should refute the notion that economic models are adequate for estimating the costs of inaction. We must gain consensus on how to bound the useful domaine of economics, for it should not be stretched. Our analytical tools, sometimes suitable for analyzing the past, are weak for dealing with the present, and particularly so for predicting future costs and conditions. It was said, too, that increased attempts to measure costs, however interesting technically, can, in fact, be misguided in the political arena. One must balance the desire for scientific truth with the ability and need to act.

Other economists, Peter Pearse was one, stated that economic analysis and benefit costs analysis, sometimes good for simple, short-term issues, are not very useful in measuring slow environmental degradation (e.g., soil changes from acid rain). Of course, environmental goods and services do have value. But with the current state of economic analysis tools and available information we can produce only imprecise estimates of costs. Any presumption that there is, or could be, a consensus on a set of values for environmental goods that could, in turn, be reflected in a set of prices, is wrong. Prices simply do not reflect values inherent in long time horizons.

When we attempt to employ economic analysis in environmental decision making we are confronted with immediate, concrete, and sometimes personal costs on the one hand, against sometimes distant, diffuse, unpredictable, generalized and aggregate benefits on the other. Natural system concerns, as was pointed out many times, are often long term and complex, and that presents difficult problems of

analysis. We have not learned how to simplify the implications of natural systems information in a form that decision-makers can readily employ.

Kenneth Boulding suggested that we put more than a market value on the environment, there is the "goodness function." The standard economic models do not take into account these environmental changes. The evaluation of things is damned untidy.

Jim MacNeill said that economic analysis is being used to justify unsatisfactory, unsustainable development.

The problem of externalities was discussed. We are dealing with a whole set of products with no prices on them. People make a lot of money, said Sir Stafford Beer, from pushing things downstream; this is another failure of the market.

Peter Victor was one of the few economists attending who defended the possibilities of better employing market forces. The idea of the failure of the market mechanism is not new, it is decades old, he said. But proposals for better employing the market should be on the table. Prices are wrong on many environmental goals and services but we should work to set them right. One idea, of course, is to create more private property rights.

Jim MacNeill highlighted how market forces are distorted by subsidies which encourage utilities, industry, farmers, and others to engage in unsustainable practices.

Relevance of the Economic Model

A work group report at Waterloo addressed weaknesses in the market economic model which, it assumed, will be with us for a few decades more, and which summarizes some of the points made above:

1. Prices do not reflect values inherent in long-term horizons (i.e., inter-generational exchange).
2. Measures of economic productivity ignore natural productivity.
3. The economic model encourages technologically increased natural productivity without considering the long-term negative effects.
4. Flaws in the system of national accounting render it inadequate in the measuring of production, income and national assets.

All in all, at both workshops, the failure of the market in this area and the failure of economic models and economic analysis tools when applied to environmental issues, were described and accepted as important contributors to our failure to act well. Nor was there a great deal of optimism about the possibility of quickly or easily improving our analytical tools. However, it should be pointed out that there was not a consensus on this. Some economists argued that we

have not yet exploited the price and market systems well for environmental purposes and action should be taken.

Politicians and Political Processes

Why have politicians been slow to act when the public is so clearly concerned? Of course, they share the value system of the greater society which will be discussed later. But participants suggested there is an explanation in the nature of politics itself.

Political processes are usually reactive and not well adapted to the nature of this problem, Douglas Wright suggested.

At Hull it was said more than once that there are two speeds – technologic and political which are short term, and natural systems which are long term. Don Chant pointed out that our society is on the short-term agenda and long-term survival is not yet a priority.

Charles Caccia, experienced and familiar with political decision making, said that the known and immediate costs of taking action on environmental protection measures, the use of discount rates, and short-term benefit cost analysis has stacked the deck in favour of short-term decisions and against longer-term environmental policies.

The time scales of natural systems do not match political time scales. How, indeed, do you turn a long-term phenomenon into something short term a politician will respond to?

Perhaps decision-makers do not believe there is a major problem, Sally Learner suggested. Or do they believe it, but those in power do not care? Are we failing to convince or failing to convert?

Rod Dobell said that there is a substantial community of decision-makers who are difficult to convince of the importance of the issue.

The people in power, our political and business leaders, are in the main doers, attuned to short term action and to developmental values. They seem comfortable with, or at least used to, a decision-making process in which decisions are made on the basis of some economic, social, and financial analysis, after which environmental matters are at best added on, or at worst neglected. There are pressures on them to seek benefits for today's electors or shareholders or customers, and to ignore the environmental costs or transfer them to someone else – the oceans, the atmosphere, the weak, or to future generations who do not have a constituency, who are unrepresented.

When attempts are made to place environmental information before decision-makers, the information is often weak and in a form which is not readily useful or cannot be integrated with economic and social analysis. It was agreed that there are not good independent data bases and indices on the state of the environment, interpreted in a useful way for decision-makers. More of that later.

Some economic advisors to decision-makers do not readily accept that nature is in charge. They remain optimistic that natural systems will continue to produce if the price is right. Many decision-makers, impressed by the cheerful science of economics – too cheerful at this stage, Kenneth Boulding said – and the marvels of technology, believe that there will be a technologic fix for all problems, that technology which has created some of the problems, will answer them. As Lars Osberg said, many believe that social, economic, and ecological systems are subject to feed-back loops that would self-correct any tendencies to ecological destruction.

Any such optimism about the operation of the economy and technology, at least under present institutional arrangements, did not receive much support from participants.

However, as will become apparent when recommendations are discussed later in the report, many did not see economic development and technology as the automatic enemy of the environment, either.

In general, it can be said that the workshops accepted that there has been a failure at the political level to act well on environmental issues.

Myths and Value Systems

In both workshops there was a great deal of discussion about the importance of the prevailing myths or value systems which drive unsatisfactory or unsustainable economic growth and marginalize environmental considerations.

That has already been alluded to in the short term considerations that underlie policy decisions.

David Peat pointed out that values exert a very deep influence indeed. Goals and priorities are set by the value system we hold. It is no good blaming the politicians and the corporations, for their value systems are simply a reflection of those held by society as a whole.

Rod Dobell said that decision-makers believe in a linear world, the market, the technologic fix, and that richer is better now. Moreover, we enjoy playing God. This powerful drive acts on the non-linear world of nature, with its major uncertainties and different time scale.

Ian Stewart put much emphasis on the vital role of values or myths. Our society is very much value-driven. The economists present described how important value systems are to the basis of economic analysis.

Don Chant said there are strong forces, strongly at work all the time, pushing us in directions we may not want to go, in directions already responsible for the problems. Developers know what they want and are prepared to shape the universe.

However, even if one accepts that our prevailing value system may generate environmental problems, many saw the failure of our present institutional design as more important.

Institutional Failure

The greatest barrier to progress on environment, Jim MacNeill said, is the way we have organized our institutions and the responsibility or accountability we expect from them.

There are major scientific challenges in this issue, but there are major institutional challenges as well. A major source of environmental problems is found in a multitude of policies which discount the future, policies generated by agencies not held accountable for their decisions with regard to the environment. These are the big decisions, the aggregate decisions by many decision-makers.

Environment has been considered as an add-on factor, protection or conservation measures to be taken external to development. The result is add-on policies and technologies managed by add-on institutions, while the main development institutions generate negative effects faster than environment and resource managers in the add-on bodies can deal with them.

Fred Roots, for one, argued that point. Environment has been considered a separate item, the responsibility of one minister. Actions on agricultural policies, energy policies, trade policies, and other such development policies, cannot be taken by the minister of the environment. His actions have mostly to do with reaction to environmental damage. Jim MacNeill added that responsibility should lie with the ministers for industry and finance, and agriculture and corporate industry leaders. Where the powerful decision-makers are not given the responsibility and accountability, it ends up on the shoulders of the comparatively weak minister of environment who has been given the problem but lacks power. It is a classic case where power and problems do not match.

MacNeill argued for a strengthening of environmental agencies politically and financially to deal with the increasing environmental costs of unsustainable development, and for making central and sectoral agencies responsible and accountable for the impact of their policies and budgets on the environmental resource base.

Sir Stafford Beer joined others in saying that our present organizations have accreted out of history, and their institutional structures must be redesigned.

Don Chant reinforced the view that institutions are important and said we have not built institutions for sustainable development and survival, to deal with the broader picture.

In introducing a subject which occupied a major part of the discussion at the second meeting, the Brundtland thinking, Jim MacNeill said that our present process of decision making takes economic and sectoral policies generated by major central institutions as given, and then adds environmental factors in an attempt to ameliorate their effect. He showed how environment and economy are one, and argued that we need action to express that.

In a brief address and in a paper Gail Stewart strongly reiterated the central point that environment has simply not been plugged in at the place where planning and decision making begin.

Fraser Mustard felt that we are talking about the need for profound and deep change. He doubted that present institutional structures can handle the needed changes.

Clearly, participants felt that a major cause of failure lies in our institutions where environmental concerns remain marginalized.

Lack of Sound Information

Particularly at Waterloo there was discussion about the lack of good information on the environment to support decision making. There is a great weakness in environmental reporting. We do not have neutral, credible, and independent data bases. There is a dearth of information on the state of the environment or the sustainability of the economy. Our national accounts fail to report on the health of our existing stock of resources.

Summary

The workshops came to the conclusion that there is a serious environmental problem, that we have failed to date to address it well and act on it effectively. Success has been limited since Stockholm, and we are slipping back in many areas.

They suggested a number of basic reasons for failure. The operation of the market and our economic models and analysis tools have not proven to be effective in addressing environment. Many of our decision-makers are either not convinced of the seriousness of the issue or have not enough good information before them to act, or believe that economics and technology will fix it, all underlain by a pervasive value system. Our public institutions have failed because they have marginalized environment, divorcing development and environmental decisions when, in fact, they are strongly related.

If one accepts the diagnosis of the ills, then a good part of the path to cure is evident and the workshops turned with considerable eagerness to recommendations for action.

What Needs To Be Done – An Agenda for Action

Having talked about the seriousness of the environmental problem and its nature, and having recognized at least some of the major reasons for failure to meet it, the workshop members were keen to consider what now should be done.

An Optimistic View

The atmosphere was not heavy with doom and gloom. It is not too late to act and the lines of new approaches are evident. At Waterloo, Fred Roots at the beginning sounded a positive note that was taken up by others. We now have a window of opportunity provided by the Brundtland report, he said.

Time at Hull was spent discussing the costs of inaction, and measuring the costs, and the use of economic analysis tools, and Waterloo went on to a discussion of economic models. Although there was much negative comment about the question of the market and the use of economic analysis, most members were not prepared to entirely abandon the idea of improved use of economic analysis approaches. But it is fair to say at the same time that they did not see these as a main key to breakthrough.

Bringing Social Scientists and Natural Scientists Together

Economists and natural scientists seldom have worked well together on environmental problems. We should work harder at providing opportunities to bring them together. Economists, whatever their failures on environment to date, have a long and successful track record of putting effective information and analysis before decision-makers. When environment is considered central in decision making, as economics is, then better analysis tools will be developed, and even prices will be more widely employed when they are suitable.

As the workshops progressed the importance of societal myths, values or ethics, received increasing attention. Many argued we need a new value system with regard to environment because our existing driving developmental values, our ideas of individualism and self-interest, are a large part of the problem. Changed value systems are then an important part of the solution.

As Fred Roots suggested, for the first time in human history we must look at the relationship between the workings of the planet and the workings of our social system.

Ian Stewart, at Waterloo, argued we need a reorganization of public myths, a social rationale, a new agreed-upon system of statements, because in the absence of public myths coherent public action of the kind we seek becomes difficult to sustain. The economy operates within the biosphere rather than alongside it.

Lars Osberg said that economic development is not the enemy of the environment, rather that it creates the resources which enables long-run environmental issues to be addressed, but added that the kind of economic development is at issue. At the same time he joined those calling for social change in saying that the evolution of social values toward the environment is central to the chances we have to avoid environmental disaster.

Most of us have a concern for future generations, it was said, and a major portion of our bequest to future generations is the quality of the environment we leave behind. We should adopt the premise that certain aspects of the environment should be maintained intact from generation to generation, like a family heirloom that has no explicit price because we have no intention of selling it. By emphasizing the stewardship responsibility of this generation, one would provide an ethical basis for the basic idea of a sustainable development of the world's resources. At Hull, employing a theatrical metaphor, participants agreed we must "leave the props behind when we go."

Rod Dobell said that the problem of balancing the property rights in the market gives rise to another view about the value of these resources, a stewardship concept which substitutes the idea of a bequest for the idea of evaluation. North American Indian government is a possible precept-driven model, a moral-based structure for stewardship. The principle of stewardship provides an alternative to the strictly analytical process and a basis for progress on environmental issues.

At Hull, Gail Stewart stated that there must be a fundamental shift in attitudes and values. She has come to the conclusion that environment must be regarded as the context of all our activities. Environment should be plugged in as the central contextual consideration at the point where decision making and planning commence.

Most participants seemed ready to accept and promote the importance of basic values and ethical change—new myths. But, accepting that, most were keen to promote more immediate actions now.

Monte Hummel, at Hull, showed some impatience with those who talk so much about uncertainty, or lack of understanding, or the problems of present value systems or institutions. He argued strongly, as many conservationists do, that we are clear on many things that need to be done, and needed and successful actions can be taken now.

At both workshops the value of increased public participation was advocated as a means for improving environmental performance. The public is strongly concerned about the environment, as public opinion polls clearly show. Where there is real involvement there will

be much interest, and effective public input and action will follow. Local people, confronted with issues that become more understandable because they are immediate in their areas, will take the longer view, more so than distant governments, and they will tend to see the problems in an integrated way, free of institutional and bureaucratic blinders. It is effective to decentralize issues when that is at all possible, for that will translate into action at that level. That fosters a "thinking globally, acting locally" approach. Do not look to senior politicians, it was suggested, to trigger the necessary pressures on government.

An Action Agenda – Brundtland Pros and Cons

Turning to an action agenda, members gave much attention to the Brundtland report. Douglas Wright endorsed the report, saying it has defined the issue better than ever before in scientific and political terms. The Brundtland prescription simply can not be ignored, said Fred Roots.

Jim MacNeill pointed out again that present decision-making processes take economic and sectoral policies as given, then add environmental factors to ameliorate their ill effects. He showed how Brundtland brings environment and economy together and how they are mutually supportive. The report is a political document full of suggestions on how to achieve sustainable development. It argues that sustainable development must become the goal of all agencies; they must integrate environment and economy and be held accountable for doing so by the media, by parliamentary committees, by NGOs.

Rod Dobell saw a duality in the environmental discussion, a duality that was apparently faced by Brundtland. When we talk of the bigger, longer term, almost unknowable issues, our concern cannot be weighed by markets and technology, but it lies with species, and nature and stewardship, with a sense of social responsibility. But the Brundtland staff thought they saw a way to turn this apparent contradiction into an economic analysis model that present-day decision-makers could more readily respond to.

Kenneth Boulding said the report is a little on the preachy side, but it suggests an approach whereby we might change the acts of the powerful.

Ian Stewart was less certain that its conceptual basis is valid. Brundtland calls for law, equity, government action, international action, when so much of that prescription runs counter to the current myths – individualism, self-interest, virtue of less government. It fails to confront the ideological gulf between where we are and where we ought to be. It has a "have your cake" quality that runs the risk of disillusion. It neglects the radical prescriptions that are needed.

These reservations were answered by a chorus of defenders of the value of Brundtland. Could not one make a more optimistic interpretation? It is true the report does not confront some of the prevailing myths, but it suggests an approach that promises to be workable, partly because it is congenial to the existing power centres and because it casts prescriptions acceptable in a private sector setting.

Diane Cohen argued that the information-based economy is bringing new promising things and we have not seen them all yet. International cooperation is not all that bad today. After October 19, international cooperation averted international economic disaster. There are many examples of cooperation when people share information and goals.

Tony Dorcey also argued that we should not miss what Brundtland offers. It is the right thing at the right time to get needed advance. It is a realistic strategy with which to achieve progress.

One can be philosophical or practical, Charles Caccia said, but implied that now is the time to be politically realistic. The system will move if the incentives are there. To tackle the sustainable development idea, let us look at what sustainable development means in agriculture, transport, energy, and forests, and what it means to the management of pollution and water and soil and air.

Hull participants noted that Brundtland seems to be catching public attention. It brings seemingly opposing forces together, reducing counter-productive confrontation which has been common over the past couple of decades, and it spawned the Task Force on Environment and Economy which promises to be a major step forward in Canada. The sustainable development idea is a piece of genius for it provides an umbrella or framework that keeps the issue whole and non-fragmented and brings all the actors together. It provides an embracing framework that brings environment into the centre of decision making. We now need to develop the institutions, the processes, and the decision-making tools to make the idea effective in practice. Many suggestions were made which will be discussed below.

There were recommendations for improvements in environmental information. But, before those are discussed, it should be pointed out that participants argued many times that, for many issues, we have enough information to act now. Lack of knowledge has not often been the main barrier to progress. Even with limited knowledge on some environmental issues we do know enough to act. Economic development analysts and decision-makers often act on the basis of poor or weak information. Perhaps environmental analysts are inhibited simply by lack of experience in presenting information for decision making. At Hull a point much emphasized was that we often know what we want to and what we do not want to do, and we

need not study issues to death. As Kenneth Boulding said, we do know a lot – that's our great strength.

Recommendations on Data and Information

Environmental information, everyone recognizes, is one of the crucial keys to planning and evaluating performance. The Task Force on Environment and Economy recommended the development of environmental data bases and the need for co-operation in this between Environment Canada and Statistics Canada. There is agreement that environmental information is still in an embryonic phase and that much more development is required.

When it comes to the question of what form that development should take, there is a multitude of views. Some want an accounting system, much like the Gross National Accounts, that captures all the relevant stocks and flows of importance to environmental concerns in terms of a suitable common measure. Others would like a single index value which would tell the public and politicians which way the environment is moving. Others would opt for more specific information, for example the development of national and regional data on contaminants in air, drinking water, the quality of soils, and the like.

Further, there is a divergence of views on the "currency" in which environmental data might be expressed. Some hope that environmental accounts can be given dollar values. Other suggest that the far more meaningful measures are in physical terms, as dollar values inevitably reflect value judgments which differ among different sectors of society.

When it comes to the question of subject matter, again there are various perspectives. Ambient conditions have formed the mainstay of environmental data in most systems of account. Yet this leaves out the key factors which are responsible for and respond to environmental change – namely, human activity. A comprehensive accounting of the environment needs to capture in some way the dynamic interplay of human activity and environmental change. For starters, the main aspects of human activity that promote environmental change need to be identified. It is increasingly recognized that this encompasses far more than a catalogue of loadings of various industries and municipalities to air and water. It also includes all kinds of land transformations, harvesting activities, introductions of exotic species, climate modification, and the like.

The workshops served more to articulate these questions than to provide the answers. If there was one conclusion that emerged from these diffuse discussions, it was that the current environmental information is insufficient to provide bases for decisions on sustainable development. There are serious flaws in the system of

national accounting on the state and health of natural assets and environmental resources, and measures of production are inadequate.

There were some general recommendations.

There should be periodic state of the environment, stewardship reports by credible, independent agencies to provide information in a form in which the meaning can be understood by the public and policy makers.

We see the vital importance of a better understanding of the environment-economy linkages. Much more study and research needs to be done to clarify those linkages and to provide information that can be employed in policy making in agriculture, energy, industrial development, urban design, and so on.

Recommendations on Institutions and Institutional Change

There were a number of recommendations that major independent institutions of the country should turn their attention to sustainable development as a major issue. Examples are the turning of the Economic Council into a Council for Environment and Sustainable Development and joint work on sustainable development by independent institutions like the IRPP and the Royal Society.

Environment must be made a central issue and there were recommendations to move it to centre stage by strengthening environmental agencies, establishing sustainable development as an over-riding national goal, requiring accountability from all actors in treating the environment on a sustainable basis, and changing the mandate of government departments, in particular those concerned with finance, economic development and central policy advice, to include responsibilities for sustainable development.

Then there were recommendations for some specific new institutions, an environmental ombudsman or a parliamentary commission which would gather and publish information and act as a watchdog on progress on sustainable development, a new parliamentary committee specifically for sustainable development issues, and a special section in cabinet documents on environmental considerations.

There were a number of specific recommendations on public participation, on Third World development, and for a national conference on sustainable development which are listed in the beginning of this report.

There was a call for action to implement the report of the National Task Force on Environment and Economy now.

Papers from the Hull Workshop

Chapter I

Counting the Cost

F. David Peat

This weekend we have to discuss a range of topics that are important to all of us. I would like to suggest that there could be something very different about this workshop. We all have our professional persona in lectures, committee meetings, with students, or in an office. Yet once we get home to our family and friends, things can be very different. In a sense that is where our reality resides, it is the place we return to in the evening. The essence of our life lies with the family, income, standard of living, the type of society we live in, where we go for a vacation, the food we eat, our general state of health, and the environment around us.

But all this is exactly what may change in unpredictable ways in the future. All this is exactly what we are supposed to be discussing this weekend. We're not talking about abstractions, or scholarly topics, or politics, although we may pretend that we are. We are discussing our homes and our children's future. That is what is different about this weekend. And, at the end of the talk I want to suggest that the very nature of such topics raises serious barriers to free and open discussion together.

Essentially I would like to cover three main topics:

1. Can we understand these problems? For the entangled and entrained nature of the issues that face us is of exceptional complexity.
2. Can we count the cost? The non-linear nature of these problems and their extreme subtlety and complexity may preclude predictability and control. In other words, some new and more creative response may be required.
3. Can we even talk together? All these problems involve goals and priorities which are generally unquestioned by our society and, in turn, these lead back to our own deeply held values. It becomes extremely difficult to talk openly when matters of such weight are involved. How are our dialogues to proceed?

The Problems Which Face Us

The Environment

People cut down forests in the Third World because they have no alternative. Hundreds of years ago, in a certain region of India, people cut down the trees for firewood and were then forced to burn animal dung as fuel. The result was a total destruction of the whole region, leaving it infertile. While that process probably took many decades, today we can do the whole thing much faster with aerosol cans, oil spills, and radiation leaks. We know that the environment is highly complex and sensitive, yet, in other aspects resilient. We also know that whatever we do to the environment may resonate around the world. But these environmental issues also involve social issues, the nature of the Third World, our commitment to progress, etc.

Health

Topics such as environment, diet, lifestyle, and occupation are all entangled with the general problem of health. In other words, the issues of health, environment, economic progress, social change, and global politics cannot be separated. What will be the health problems in the future as degenerative diseases become more dominant? And what about AIDS and other new forms of disease? These are also connected with lifestyle. It could even be said that AIDS is not so much a sexual disease as a consequence of modern means of travel. Would there have been an AIDS crisis without air travel, automobiles, and railways?

Third World

Poverty takes no account of environmental standards or good diet. Our own high standards are now being won at the expense of the Third World. It is far cheaper to export dirty technology and manufacturing than to clean it up at home. The Third World, we say, will pay the price. What are the implications of that particular policy? Is the world infinite or will we one day have to foot the bill?

Social Change

The world is changing faster than ever before. Who could have predicted the implications of gunpowder, transistors, refrigeration, railways, automobiles, flight, computers, plastics, the birth control pill, television, antibiotics?

How then can we today predict the implications of our present, even faster moving technologies?

Prediction and Control

We have been asked to count the cost of inaction, of what will happen if we continue along our present path for 20, 100, 1000 years into the future. Will there indeed be a future?

For decades, for centuries we have accepted the virtues of progress and now we have to stand up and be counted. We have to determine the implications of our actions and inaction, we now have to add up the bill and be prepared to pay it.

But can we really count the cost? I would suggest that we often have an old-fashioned and over-optimistic view of science. We assume that the technology which created a problem in the first place can also be used to solve it. According to this argument we can first analyse, quantify, and then mathematically describe a system. This leads to prediction and finally to a solution and control. But can nature always be measured and quantified and determined? And even if the equations for deterministic systems are known and fed into a computer, can we still count on well-behaved solutions and complete predictions? Can we indeed count the cost?

But let me offer a parable. It concerns the great physicist Henri Poincaré who in the last days of the 19th century tried to calculate the motion of an asteroid. (The same problem, you may recall, that Sherlock Holmes arch-enemy, Moriarity, also tackled.) It was simple enough to determine the asteroid's motion around the sun, but what about the effect of a third body – the planet Jupiter? At first it looked as if a small extra pull would produce only a small extra effect. The motion of the asteroid would be perturbed in a tiny way. Yet Poincaré suddenly discovered that there were other orbits possible – totally

chaotic ones, orbits in which the asteroid plunges through the solar system, moving at random or in an infinitely complex way. Moreover, no matter how small he made the effect of that third body, Jupiter, these monstrous orbits would not go away.

A bomb had shattered the structure of Newton's orderly physics. Poincaré had shown that some systems are inherently unpredictable. They may behave regularly for centuries, for tens of centuries, then suddenly jump catastrophically into totally new motions, behaviours that are unpredictable and chaotic. What holds for the motion of an asteroid is even more valid for the environment, society, the neurosystem, and the impact of new technologies.

The key is what physicists call non-linear systems, systems that cannot be described by the linear equations of 19th-century physics. You must have seen some of those amazing pictures produced by the new fractal mathematics, in particular the Mandelbrot set which has been called the most complex thing in the universe. The Mandelbrot fractal has an infinite wealth of detail. Pick a point and magnify it 100 times and observe a totally new pattern. Magnify this 100 to 10,000 million times and new details appear. The Mandelbrot set is deterministic in the sense that it can be generated by a very simple computer program. Yet it is totally unpredictable in the sense that knowing about one region cannot prepare you for what happens next.

It is exactly these Mandelbrot fractals that offer the best description for the chaotic motion of non-linear systems such as Poincaré's asteroid. Physicists call these "strange attractors." Label an asteroid by its speed and position, and plot out the result. What you end up with is not a nice, well-behaved orbit but an infinitely complex fractal, a strange attractor. Study the behavior of a non-linear system over the last hour, even for the last century, and you still cannot predict what will happen one second later.

This is the message of non-linearity. It is beyond prediction and control. And exactly this form of non-linearity lies at the heart of the questions we now face.

It is becoming ever clearer that the sorts of systems we are discussing this weekend are essentially non-linear. Whenever we meet such non-linear systems we run into the following characteristics:

Interconnectedness

Non-linear systems must be considered as a whole; they are interconnected with a vast web of other systems. The traditional reductionist approach is therefore limited. This can lead to the whole problem of fragmentation, that is, trying to treat things which are in some way significantly interconnected as separate or trying to put together things that are relatively autonomous. In other words,

fragmentation involves the erection of inappropriate boundaries. With a fragmentary approach it is impossible to see the whole problem or situation for what it really is. The result will be inappropriate and ill-judged action.

Unexpected Behaviour

Old solutions do not always prepare us for new ones. Always be on the lookout for novel forms of behaviour.

Catastrophic Change

Systems can have a long history of gradual, continuous change and then suddenly jump to some new mode in which different behaviour is exhibited and a totally new description is needed.

Limits to Description

It may turn out that certain systems are too complicated ever to be quantified. It is said that weather will remain unpredictable because we can never gather sufficient initial data; the fractal dimension of weather collecting stations is lower than the fractal dimension of the weather itself.

Bifurcations or Decision Points

There are sensitive regions where a system can branch into one or other areas. Decisions may not always be reversible.

Butterfly Effect

Even if we knew to parts in billions upon billions the exact state of a deterministic system, it may be so sensitive to tiny errors in this information or in its boundary conditions that within a few tens of iterations all knowledge of the system may be lost. The Butterfly Effect, so termed by Lorenz with reference to the weather, illustrates yet another danger inherent in fragmentation. We may believe that it is possible to draw a boundary around a particular system and to treat it as separate from other systems and concerns. Under certain circumstances this may be true, but in other conditions the system may be sensitive to factors which lie outside its boundaries.

Chaos

Orderly systems may move into regions of complex oscillation or even chaos. This can happen with quite simple systems such as population growth in insects. These chaotic regions can be considered as being determined by pure chance or, alternatively, having infinite complexity.

Intermittency

Occasionally, regions of intermittent order appear out of chaos. Should we regard order as exception against a background of chaos or are violent fluctuations the aberrations. Are periods of calm simply intermittent regions embedded within an infinitely complex order?

Order out of Chaos and Dissipative Systems

I. Prigogine amongst others has stressed how open systems – cities, a living cell, the planet – fed with energy or materials, can move to extremely stable domains. Over large regions such dissipative structures will resist change, or will change in predictable ways. Prigogine's suggestion is that systems evolve through a series of decision points. At first the new system is sensitive but it soon settles down into prolonged stability. However, it is always possible for environmental changes to take us to new decision points and totally new structures and forms of behaviour.

Conclusion

Nature's systems are infinitely subtle and complex. The problems we are looking at are deeply entangled and entrained with each other. The traditional approaches of analysis, prediction and control will not work. We need new approaches and the question is, can we be as fast and as subtle as the systems under study? Can we work together in co-operative and creative ways?

Can We Have a Dialogue?

Society is on the back of a runaway horse. Up to now we have managed to hang on. Can we now be fast and subtle enough to take control? Has the motion of the horse lulled us into a illusory state of security? The problems we face are complex in the extreme, they are entrained and entangled with hosts of other issues. Often our attempts to deal with them result in fragmentary views or actions. Can we work together with sufficient creativity to meet this challenge?

Often society has tended simply to react to problems and new situations in rather mechanical and uncreative ways. Why should this be?

The answer, I think, is that we all tend to operate from sets of values and priorities which are relatively fixed and, in many cases, not consciously appreciated. Whenever we operate from fixed and limited positions, we tend to see things in fragmentary ways and to respond mechanically. At best we come up with stop-gap solutions.

At worse we fall into the shared illusion that we are really in control of the situation.

Think of words like progress, competition, expansion, incentives, innovation, development – or conservation, limits, equilibrium.

They lie at the basis of all we are talking about this weekend. They are the positions from which we take action and the goals to which we aspire. They are the priories set by individuals, corporations, nations, and societies. While we may not always be consciously aware of the nature of these values, nevertheless they exert a deep influence. They are the paradigms or infrastructures of our thought and action. They are enfolded in the very language we speak and in the organization of society and the family. And these values are entrained with others of even more fundamental nature that concern the family, civil rights, democracy, freedom, the individual, sexuality, religion, fears of world war, violence, aggression, and so on. In talking about the environment, for example, we are operating, often unconsciously, from all those values which each of us hold dear and which are never called into question.

Serious problems arise when we act from such fixed and unexamined positions. Their satisfaction alone become the major goal rather than the creative response to problems in hand. We tend to operate from extremes and to deny the rich and subtle areas which lie between – what David Bohm and I have called "the order between." In addition, when nations or individuals entertain values which differ radically from others, then free and open dialogue becomes impossible. When values of such emotive power come into collision, rational debate flies out of the window. We have probably all seen examples of a scientific discussion which gets out of hand. The reason is generally because, while on the surface the opponents are debating technical issues, the underlying discussion involves conflicting ideas of what scientific truth, or the nature of a theory, or scientific metaphysics really means. The best that can be hoped for in such a situation is a compromise, or a negotiated position, which implicitly denies the rich and subtle unexplored orders that lie between the proponents. However, if it were possible to open the discussion still further and address the various values, then a more intelligent result may be possible.

These, then, are the problems which face us this weekend. Not only will it be difficult to question our goals and priorities, it may not even be possible to bring our presuppositions and paradigms into open discussion. Any attempt to question the absolute necessities of our society will always be met with great resistance. So it is no good blaming politicians, scientist, technologists or corporations for the mess we are in – their values are simply the reflections of those held by society as a whole. Something radically new is required, a more

creative approach, if we are to preserve not only our society but the planet we live on so that we are in a position to hand on something to our children's children.

Chapter II

On Measurement and Value in Environmental Economics

Thomas D. Crocker

Introduction

What is academically important in natural resource and environmental questions has become progressively less distinguishable from what is academically and societally urgent. Emotions run high. Environmentalists repeat again and again that too little is being done to preserve and protect natural resources, especially environmental life support and amenity functions. Developers disagree and, with every downturn in the commercial and industrial economy, they find audiences more attuned to their proposals to use the environment as a source of raw materials and as a receptacle for the waste from consumption and fabrication activities. The developers identify themselves with progress and assert that environmental regulation stifles it. Neither environmentalists nor developers provide coherent and reasonably comprehensive criteria for deciding what is "too little" or "excessive." Factionalism and adversarial proceedings therefore rule. Unless realism is self-serving the factions ignore real-world data, assume worst-case scenarios, propose technology-forcing controls, and fail to validate supposed commercial or environmental improvements. For several academic disciplines, including economics, analytical constructs and empirical methods, that took one hundred years or more to establish, have recently been drawn tight in one-tenth that time across a practical problem spectrum at least ten times as wide. The common neglect of

elementary but fundamental economic concepts such as opportunity cost, marginal value, and the interaction of supply, demand, and price accentuates this strain. When combined with inattention to and misuse of the specialized concepts and tools of environmental economics, this neglect often results in the wrong variables and the wrong problems, or the wrong versions of them, being thrown into prominence. Accurate visions of reality are lost and, by most socially meaningful criteria, excessive human and environmental costs follow.

Economic Analysis and Environmental Decisions

The potential for human abuse of the natural environment stems from two primary sources. The first is the so-called nonexclusivity or commons problem. Because natural resources such as air and water do not respect property lines, placing them under simple forms of private ownership is generally impossible: the owners would be unable at low cost to exclude others from using their property. Institutional designs must therefore be created to substitute for simple private property forms. Otherwise, non-owners will regard the resource as a free good, leading to its overuse and, often, degradation and even ruin.

Second, the potential for abuse exists because of the wide range of commercial and industrial interests whose decisions affect what happens to the natural environment. They rarely benefit directly from actions that protect it and they infrequently suffer losses from actions that harm it. Consequently, they have neither a great incentive nor disincentive to account for environmental impacts in their decisions.

Economic analysis and its empirical tools can assist in two ways to generate information helpful in overcoming the environmental insults fostered by nonexclusivity and by commercial and industrial detachment. First, knowledge about natural resource issues must ultimately be defined and refined in dimensions corresponding to those in which real-world decision agents operate. Because some human decision variables simultaneously influence, and are influenced by, the behavior of natural resource systems, economic analysis is frequently necessary to impart a policy-relevant form of research designs and results in disciplines other than economics.

Second, economic analysis and its empirical manifestations when applied to environmental issues (benefit-cost analyses) provide information that can inform contestants in the political arena about what a given change is likely to hold for them. Occasionally the bottom-line aggregates which any benefit-cost analysis can generate will be informative.[1] More often, information that the analysis contains about market response and agent adaptations will be much

more useful, allowing the beholder to draw inferences about the particulars of a change as it affects his immediate circumstances. He can then use this information to construct a political strategy: to him, knowledge about aggregate benefits and costs is, at best, of only abstract interest.

Economic efficiency and the bottom-line aggregates that a benefit-cost analysis can produce coincide if, and only if, all potential gains from voluntary exchange are realized, given the applicable laws of nature and of man. Effective markets guarantee these gains. In benefit-cost analyses, the gains are calculated, but the voluntary exchanges that form them need not be consummated. Implicitly, therefore, those who would adopt a rational planning, bottom-line aggregate perspective of benefit-cost analysis see the losers from a change as having lost a privilege rather than a right. A "mere" privilege is largess from a higher authority; a right cannot be revoked without constitutionally guaranteed notices and hearings.

Noneconomic commentators on benefit-cost analysis generally seem to view government as a rational planner who denies the relevance of individual circumstances in order to implement its conception of the collective will. Losers are to be coerced into a change if the collective will is served. Any defense of this view must take one well beyond the bounds of technical economics and into the realm of political philosophy and ethics.

Moreover, the day-to-day practices of North American democracies do not support the rational planner view of benefit-cost analysis. These practices use the give-and-take of government to create and transfer wealth, particularly in circumstances where markets are ineffective or otherwise rejected. One must therefore question a view which implies that government has or should have the values of a private firm in which the important thing is to tote up the personal advantages and disadvantages of an option and act only if the calculated net advantages are positive. The bottom-line numbers of benefit-cost analysis are useful only to those who will gain if government does efficient accounting for whatever factors are included in the analysis.

Economic efficiency is more likely to be served if the analytical framework that supports the process of benefit-cost analysis is used to inform participants in collective choice exercises of the particular economic consequences to them of a proposed environmental change. Musings about nonexistent rational central planners who must keep the accounts serves neither the process of benefit-cost analysis nor the process of collective choice. When applied under a rational planning world view, benefit-cost analysis is reduced to practical insignificance because it informs very few collective-choice participants of their particular prospects from an environmental change.

The bottom-line emphasis of the rational planner is misconceived. Because it encourages myopia, it can be self-defeating as well. In many minds accounting, if competently done, is synonymous with precision. A truism of classical statistics holds that repeated samples enhance precision. Delaying decisions may allow economically inefficient environmental damages to proceed unchecked while the samples, that will maximize precision, are being gathered and processed. In addition, insistence that benefit-cost accounts be scientific, where "scientific" is taken to mean minimization of the probability of treating as true some hypothesized environmental impact that really is not true (false positive) also encourages myopia. This cigarette company version of truth fails to recognize that reductions in false positives necessarily increase the chances of wrongly rejecting a true hypothesis (a false negative). If the hypothesis that an impact exists is correct, then the environment is allowed to decay so that a simplistic version of truth may be served.[2] Properly, the net benefits of requiring proof of environmental damages should be weighed against the net benefits of requiring proof of no environmental damages.

Finally, scientific precision is often equated with being able to assign an observed environmental impact to a unique story about its source.[3] Ambiguities and rational central planning do not mix well. When environmental effects are somewhat irreversible, Tesfatsion (1980) has shown that the opportunity losses associated with the myopia caused by single-story worship become greater as the degree of uncertainty about future outcomes increases and as the degree of positive correlation among period-by-period economic returns declines. Many would-be rational planners seem unaware that current decisions, into which possible irreversible negative environmental impacts do not enter, will increase future uncertainties and reduce the degree of correlation among period-by-period returns.

Benefit-Cost Analysis and Environmental Change

Assessments of the economic consequences of environmental change try to estimate those differences in wealth equivalents that will leave welfare intact, given a change or the prospect of a change. The wealth equivalents are defined as differences in the sums of buyer surpluses and seller quasi-rents over two or more policy-relevant pollution levels. Buyer surplus portrays the difference between the maximum a representative individual would be willing to commit himself to pay for a secure property claim to a commodity unit and what he in fact has to pay. Similarly, seller quasi-rent is the difference between what one receives for supplying a secure property claim to a commodity unit

and the minimum one must receive in order to be willing to commit to that supply. The sum of seller quasi-rent and buyer surplus is thus a measure of the prospective net benefits from the availability of a secure claim upon a commodity. The observable unit prices of secure claims to other commodities that could provide equal satisfaction set an upper bound to the buyer's maximum willingness-to-pay; the earnings his resources could obtain in other activities set a lower bound on the minimum reward the seller must receive. Maximum willingness-to-pay represents demand; the minimum necessary reward defines supply.

A complete assessment of economic consequences requires three kinds of information: (1) the differential changes that pollution control causes in production and consumption opportunities; (2) the responses of input and output market prices to these changes; and (3) the input and output changes that affected individuals make to minimize losses or maximize gains from changes in production and consumption opportunities and in the prices of these opportunities. Natural science studies of dose-response functions are the primary source of information for the first requirement. Evaluation of the latter two requirements represents the economics portion of net benefits assessment. If an environmental change causes substantial changes in outputs, then price and quality changes can occur which, in turn, lead to further market-induced output changes. Moreover, even if prices remain constant, natural science information will still fail to provide accurate indications of output changes when individuals can alter production practices and the types of outputs produced. Thus, accurate information on the economic consequences of environmental change can be achieved only if the reciprocal relations between physical and biological changes and the responses of individuals and institutions are explicitly recognized.

Empirical Results Without Bottom-Line Numbers

I try to demonstrate in this section that economic analysis has generated useful empirical knowledge about environmental impacts beyond bottom-line numbers. Although numerical results and the conditions under which they were derived may differ, diverse studies can exhibit common patterns of behavioural responses. Subsequent researchers can then use these commonalities to restrict the dimensions of their analytical and empirical problems: they have a set of priors on which to base research directions. Because I have participated extensively in projects dealing with the impact of air pollution upon commercial agriculture, the sample of commonalities that I select perhaps gives undue attention to these commodities. The responses of other material commodities are probably similar.

However, studies of the economic value of environmental commodities that evoke images, or for which the reasons for pleasure can only be found ex post (e.g., atmospheric visibility), exhibit their own commonalities.

1. *Increasing air pollution causes losses in the total economic surplus from the production and consumption of agricultural outputs to increase at an increasing rate.* The estimates of the following studies display this pattern: Howitt, Gossard, and Adams (1984); Adams and Crocker (1985); Adams, Crocker, and Katz (1984); Kopp, et al. (1985); Adams and McCarl (1985); Adams, Crocker, and Katz (1985); Adams, Hamilton, and McCarl (1986); Shortle, Dunn, and Phillips (1986); and Adams, Callaway, and McCarl (1986). With the exception of the last, each of these studies dealt with ozone. No thoroughly consistent pattern appears with respect to the absolute magnitude of this rate of change in total surplus.

2. *Growers can gain from increases in air pollution.* Adams, Callaway, and McCarl (1986) found that substantial increases in acid deposition enhance the quasi-rents of soybean growers. Shortle, Dunn, and Phillips (1986) estimated that these growers benefit similarly from ozone increases. Adams and McCarl (1985) got the same result for corn, soybean, and wheat growers, considered as a package. A sufficient condition for these findings is that the pollution-induced percentage reduction in output quantity be less than the percentage increase in market price that the supply reduction causes. All other studies conclude that growers lose from increased air pollution. However, those studies, such as Crocker and Regans (1985) and Shriner, et al. (1982), which disregard market price changes, and which therefore guarantee producer losses with increased pollution, cannot be taken seriously as evidence supporting the hypothesis of grower losses.

3. *Losses in buyer surpluses are a very significant portion of the total losses that air pollution causes agriculture.* Of the studies that accounted for air pollution-induced changes in the prices of agricultural outputs, buyer surplus losses as a percentage of total losses range from a low of 22 per cent (Adams, Crocker, and Thanavibulchai (1982)) to a high of 100 per cent (Adams and McCarl (1985)). Given that growers can sometimes benefit from air pollution increases, methods which disregard consumer impacts can, it seems, understate total losses in surplus and grossly mistake the distribution of these welfare effects.

4. *For air pollution increases, percentage losses in total economic surplus are no greater than, and nearly always less, than the percentage changes in biological yields which triggered these losses; for air pollution decreases, percentage changes in seller surplus are no less than, and nearly always greater in absolute terms, than the percentage changes in biological yields which triggered these seller impacts.* Every study which accounted for price effects of crop and input substitutions obtained this result. It is unsurprising to anyone familiar with microeconomic theory. From the grower's perspective, an improvement in air quality removes a shackle from the grower, causing crops, cultivars, input combinations, and growing locations that had previously been nonviable to become realistic alternatives. For a given crop price, air quality improvements will certainly increase the net revenues he obtains from his former cultivar, input combination, and growing location. However, the greater the expansion in his set of possibilities, the greater the odds he will discover a cropping pattern that provides him greater net revenues under the new air quality regime than would the old pattern. Consumers will respond analogously to any price reductions; that is, they will substitute toward the good which has had a fall in relative price as well as being able to get more of the good at their previous money outlay. Depending upon the responsiveness of price to quantity changes, their percentage gains in surplus could also exceed percentage changes in yields. The substitutions allow producers and consumers to magnify the gains they would otherwise acquire if they continued to adhere to their old patterns. Similarly, substitutions allow them to attenuate the losses they would otherwise suffer from air quality declines.

5. *Air pollution increases can cause growers of relatively pollution-tolerant crops to experience percentage yield changes greater than those triggered by the pollution increase.* This phenomenon is explicitly noted by Howitt, Gossard, and Adams (1984), where growers of pollution tolerant crops like broccoli, cantaloupe, carrots, and sugar beets were also estimated to experience substantial production yield declines as air pollution increased. Adams, Crocker, and Thanavibulchai (1982) in another California study, and several studies (e.g. Brown and Smith (1984); Kopp, et al. (1985)) of the corn-soybean-wheat economy in the U.S. Midwest have produced the same finding. This counterintuitive result occurs because agriculturists substitute other inputs, especially land, for poor environmental quality; that is, reduced environmental quality causes more land and inputs such as fertilizer and pesticides to be used. If after these substitutions the pollution-intolerant crops have higher unit values than the tolerant crops, the latter will be crowded out.

This result leads to a kind of paradox: the pollution from other sources that affects agriculture encourages agricultural practices which themselves produce pollution. Conversely, a reduction in pollution from other sources could reduce some pollution that originates in agricultural practices.

6. *Changes in air pollution affect both the relative productivities of and the aggregate demand for factors of production.* Several studies have demonstrated that changes in air pollution will change the demand for specific inputs. Crocker and Horst (1981) found that the ambient ozone conditions prevailing in southern California during the mid-1970s reduced the economic productivity of selected agricultural workers by an arithmetic mean of 2.2 per cent. Ozone did not affect some workers, while others suffered productivity declines of more than 7 per cent. Howitt, Gossard, and Adams (1984); Garcia et al. (1986); Kopp, et al. (1985): and Brown and Smith (1984) have all shown that increased ozone increases the demand for land inputs.

7. *Changes in air pollution have differential effects on the comparative advantage of agricultural production regions.* Numerous studies have focused on the consequences of air pollution across large geographical areas, e.g., Adams and Crocker, (1985); Kopp et al. (1985); and Adams, Hamilton, and McCarl (1986). In order to correctly represent aggregate supply response across regions, economists typically define regions as being composed of a collection of distinct subregions where each subregion has unique characteristics in terms of crop production alternatives, resource and environmental conditions, and other attributes. The literature demonstrates that economic effects can vary sharply across regions. Specifically, studies by Adams, Hamilton and McCarl (1986); Kopp et al. (1985); and Adams, Callaway, and McCarl (1986) indicate that reductions in air pollution resulted in gains to producers in areas simultaneously characterized by high ambient pollution levels and crop mixes dominated by air pollution sensitive crops. Such gains were frequently taken in the form of expanded crop acreage. Conversely, areas with the opposite set of characteristics experienced reductions in acreages of some crops and hence a loss of "market share" for these crops. This result implies pollution-induced shifts in comparative advantage in crop production among subregions. Thus, while these analyses all found net *total* gains to society from reductions in air pollution, some subregions gained at the expense of others.

8. *Air pollution has economic transboundary effects that alter international trade flows with attendant gains and losses to exporters and importers.* The economic gains from free and open trade are well

recognized. International trade in agricultural commodities has profound effects on the welfare of consumers and growers in both exporting and importing countries. Some of the recent studies of air pollution effects incorporate a trade component, e.g., Adams, Hamilton, and McCarl (1986); and Shortle, Dunn, and Phillips (1986). In the U.S. increases in agricultural output have typically moved into the export market. Thus output increases which originate in air pollution reductions have generally moved into exports. The net effect is that foreign consumers of these commodities capture most of the consumer gains. Indeed, Adams, Hamilton, and McCarl (1986) estimated that of the total consumer gains from ambient U.S. ozone reductions, 60 per cent accrued to non-U.S. consumers. Conversely, increases in air pollution imply a reduction in the welfare of importing countries. As a result, national environmental policies can readily have economic transboundary implications even in the absence of a pollution transboundary phenomenon.

9. *The contribution of additional biological information to the accuracy and precision of economic assessments declines.* Several studies, including Crocker (1982); Adams, Crocker and Katz (1984); Adams and Crocker (1985); Howitt, Gossard, and Adams (1984); Kopp, et al. (1985); and Adams and McCarl (1985), have now demonstrated that there are some important classes of pollution impacts upon agriculture in which rather imprecise yield-response information is quite adequate for distinguishing among the economic consequences of alternative ambient pollution levels.

In their Bayesian inquiry into the robustness of economic estimates of crop damages from ambient ozone, Adams, Crocker, and Katz (1984) showed that the policy value of additional plant science yield response information declines rapidly. Forty or fewer yield response observations per crop, similar to those found in Heck et al. (1982), adequately discriminated among the differences in economic surplus in U.S. production of corn, cotton, soybeans, and wheat that ambient ozone levels of 66, 53, and 40 parts per billion generated. In an entirely different setting, Feinerman and Yaron (1983) demonstrated that the net value of information to Israeli growers about potato yield responses to soil salinity was maximized with as few as 15 and not more than 27 observations.

Adams and McCarl (1985), while studying the economic benefits of ambient ozone control for corn, soybeans, and wheat grown in the U.S. corn belt, found that changes in key natural science parameters had to be substantial if they were to translate into major changes in benefit estimates. For given pollution levels, yield responses across alternative cultivar selections and across temporal and spatial variations tended to be homogeneous, implying that additional

yield-response observations do not greatly affect economic benefit estimates.

10. *For evocative environmental commodities and for pollution-induced threats to human health, the marginal gross benefits of pollution control increase over some finite interval.* Diverse studies of the manner in which people respond to environmental phenomena have found this. The finding has a psychophysical basis in Fechner's law which says that the strength of a sensation is proportional to the negative of the logarithm of the stimulus (Baird and Noma (1978)). Averting behavior, in which potential sufferers act to reduce their pollution exposures to near-zero, also implies that there is an approximate absolute upper bound to pollution damages. Every study of the value of atmospheric visibility that does not impose decreasing marginal benefits as a precondition, finds increasing marginal benefits, e.g., Repetto (1981); Rowe, et al. (1980); and Schulze, et al. (1983). Crocker's (1985) study of the values recreationists attached to oxidant damages to standing forest stocks produced the same finding. Loehman, et al. (1979); and Smith and Desvousges (1986) got the same result for pollution-induced health risks.

Any propensity for increasing gross marginal benefits of pollution control need not reside solely in the structure of people's environmental perceptions or in their averting behavior. Crocker and Forster (1981, 1984); and Regetto (1987) have reviewed several natural system, dose-response function examples where the standard economic premise is clearly violated. The examples encompass a broad effects spectrum, including effects on soils, aquatic ecosystems, forests, and atmospheric visibility. In fact, any natural system dose-response function which has a damage threshold is likely to exhibit the largest incremental reductions in service flows in the immediate neighbourhood of the threshold. Whether the source of increasing marginal benefits be human perceptions, averting behaviour, or natural system dose-response functions, the sometime fact of increasing marginal benefits of pollution control poses an obstacle to compromise policies which allow some pollution in order to achieve some commercial and industrial development. Increasing marginal benefits of pollution control imply that all-or-nothing pollution control policies can be economically efficient.

11. *The losses from pollution-induced risks are higher when the risks are involuntary, uncontrollable, or have delayed effects.* As Spence and Zeckhauser (1972) originally demonstrated, this behaviour occurs because involuntary risks remove ex ante opportunities to adapt, uncontrollable risks remove both ex ante and ex post opportunities to adapt, and delayed effects cause subsequent as well as present

decisions to be risky. The Spence and Zeckhauser (1972) propositions have been confirmed numerous times in psychological (e.g., Fischoff, et al. (1978)); engineering (e.g., Petak and Atkisson (1982)); and economics (e.g., Jones-Lee (1974)) research studies.

12. *For evocative commodities and for pollution-induced risks, real losses in environmental quality are valued more highly than foregone potential gains of identical absolute magnitude.* Discrepancies, far greater (occasionally order-of-magnitude) than standard economic theory would predict, continue to crop up between willingness-to-pay and compensation demanded measures of the economic value to buyers of a given change, e.g., Rowe, et al. (1980); Knetsch and Sinden (1984); Smith and Desvousges (1986).[4] Although recent research indicates that the discrepancy can be narrowed considerably by "forces of learning and incentives which are present in a market" (Brookshire and Cousey 1987, 554), the relevance of this research to environmental problems is problematical at best. Environmental problems arise precisely because opportunities for learning and the application of market incentives are weak and even absent (Olsen (1982)). At present, economics lacks a convincing analytical explanation for what appears to be a widespread empirical phenomenon consistent with the folk idiom that "a bird in the hand is worth two in the bush." The next section suggests an analytical skeleton which might help to explain the discrepancy as it appears in environmental valuation exercises.

The Environment as Individualized, Nonfungible Wealth

Economists have studied natural resources since the beginnings of their discipline. Natural resources have long been viewed as a basis for national prosperity, power, and wealth. Innovations in the extraction and harnessing of energy are recognized as a major factor driving the industrial revolution and its modern information technology counterpart. Because agricultural land, forests, and fisheries are basic to food supplies, their supply and demand features have sooner or later been scrutinized by nearly all major economic thinkers of the past three centuries. In spite of their concerns with natural resource scarcity, these orthodox writers have near-universally defined the endowed wealth that constrains people's abilities to meet their objectives solely in terms of perfectly fungible commodities to which the economic agent has uninhibited access and fully secure property claims. In its benefit-cost analysis, bottom-line number manifestations, this definition is likely responsible for nontrivial undervaluations of environmental assets when the

appropriate measure of value for a harmful impact is the compensation the economic agent requires to keep his welfare intact (Knetsch (1984)). Undervaluation occurs when the agent treats as an integral part of his wealth those environmental commodities that are imperfectly fungible, for which, as with a license or easement, his enjoyment and access is somewhat restricted, and where his ability to exclude others is ambiguous. He may correctly believe that his imperfect claim is clamped by legal precedent and by convention and custom into a socially agreed though restrictive combination of rights and obligations. Though he may not be able to trade these environmental commodities to prevent a change he does not desire, their loss can affect his welfare as much as any reduction in his money income and his inventory of highly-fungible commodities.

An example perhaps makes the above assertions more vivid. Assume that I buy some rural land. Though I might feel that I have purchased the right to exclude others from being on this land, my power to enforce this exclusion cannot be included in the title change because it is not a part of civil law. The transaction, at best, can provide only the most menial discretion to self-exclude anyone than the seller. Powers of exclusion and the right to choose the degree to which to exercise these powers reside with the authorities responsible for criminal law and tort law. Their choices are strongly influenced by social policy and convention and by immediate demands upon the authorities' resources.

Consider the following simple formalisms.[5] An undressed, orthodox version of the consumer's problem requires that he select that combination of fully secure claims to perfectly fungible commodities and activities which yield him the highest utility. If his income does not permit satiation, he thus must maximize

$$U = U(z_1, z_2, \ldots z_n; q) \tag{1}$$

subject to

$$\sum_{i=1}^{n} P_i z_i = y \tag{2}$$

where U is a strictly concave, twice-differentiable utility function, z_i is the quantity purchased of the ith good or activity, P_i is its unit money price, y is money income or wealth, and q is the exogenously determined level of an environmental commodity that the individual intrinsically enjoys. Expression (2) constrains the level of (1) that the individual can attain: his wealth sets an upper bound to the utility he can achieve.

Suppose now that there are two classes of z goods and activities: those, x, having unit costs that are not sensitive to variations in the

environment, and those, w, that are sensitive. Expression (2) might then be written as

$$\sum_{j=1}^{m} C_j x_j + \sum_{k=1}^{g} K_k(q) w_k = y, \qquad j \neq k \tag{3}$$

where C is the unit cost of nonsensitive activities and K, a function of the level of the environmental commodity, is the unit cost of sensitive activities. If $dK/dq<0$, such that the unit cost of sensitive activities increases as the level of the environmental commodity falls, then it is easily seen that what the individual's money income, y, can purchase must fall. Consequently the level of (1) that can be achieved must fall. In effect, in addition to the direct loss in utility that a decline in environmental quality causes him ($\partial U/\partial_q>0$), the decline also increases his cost-of-living. His available dollars stretch less far. Thus he must travel farther and longer to catch a fish because pollution has reduced his access to trout populations, he must backpack and hike during weekdays because weekend congestion has destroyed solitude, and he must exercise before dawn because daylight traffic has increased air pollution. Pollution reduces his access to commodities from which he obtains direct satisfaction; the pollution also makes it more costly for him to consume his accustomed quantities of the w's. The utility he can obtain for a given money income is thus reduced in a fashion no different than if the governmental monetary authority or tariff authority had adopted policies which directly increased the price of the w's. Moreover, increases in K cause consumers to substitute toward the x's, typically industrially fabricated commodities whose costs exhibit little direct sensitivity to variations in the environment. In general, when the levels of nonfungible high-quality environmental commodities, to which the individual nevertheless has access, are included in his constraint system, his wealth can be substantially greater than even a dressed-up version of expression (2) would make it appear. By definition, he cannot trade this wealth, but its loss can have major impacts on what he is able to accomplish with his money income.

Summary and Conclusions

Values are based on, and are therefore to be derived from, individual human preferences. This is not as restrictive as it may first appear, for while it does not grant the natural environment equal status with human beings, it admits the legitimacy of the preferences of those individuals who believe that it ought to be so granted, along with their probably extraordinarily high valuations of particular features of

environmental assets. Benefit-cost analysis starts with this premise. A singular emphasis upon the contribution that bottom-line net benefits can make to a non-existent rational planner seriously distorts its purpose. Benefit-cost analysis provides qualitative and quantitative information about the tradeoffs that environmental decision-makers confront. It provides insight about some, even many, of the choices that people actually make, not the choices that others would like them to make. Unsurprisingly, these insights can be improved, but the fact that improvements are feasible cannot logically justify denying participants in collective decision processes information about what a policy choice will do to them. Benefit-cost analysis is an inadequate decision framework; it is a valuable support for any coherent and responsible decision framework.

Notes

1. Microeconomists generally agree that the analytical framework supporting nearly all benefit-cost analyses is especially appropriate for dealing with situations where tastes can comfortably be assumed constant, where decision consequences, but not decision processes, possess intrinsic value, and where the issues involve marginal perturbations of stable systems in the immediate neighborhood of an equilibrium.

2. I have shown elsewhere (Crocker 1984) that very lenient criteria for failing to reject study results which report negative environmental impacts can reduce the total social costs of pollution and its control. The result depends upon developers being able to take costly actions which reduce the probability of a false positive with respect to a hypothesis of an undesirable impact. Similarly, sufferers must be able to reduce the probability of a false negative.

3. The Reagan Administration in the United States has adopted this position with respect to acid deposition impacts on forests. See Crocker and Forster (1986) for some of the economic problems with this position.

4. See Takayama (1982) for the standard argument that the discrepancy should be small for most commodities.

5. Similar but much more thorough treatment can be found in Crocker (1976, 1986) and Gallagher and Smith (1985). See Deaton and Muellbauer (1980) for full-dressed coverage of the

approach that economics takes to the scarcity problem of the consumer.

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Chapter III

The Political Imperative of Quantifying the Cost of Inaction

Charles Caccia

In 1984, the OECD recognized the fact that the economy and the environment are interrelated, if not interdependent.

In 1987 the World Commission on the Environment and Development proposed the concept of sustainable development which could guide humanity into the next century with sustained economic growth.

Despite this progress, in 1988 we still do not know how to quantify the damage to the environment, and to the economy in the long-term, that results when we do not take action to prevent pollution.

Dr. David Bates at the University of British Columbia conducted a study on respiratory diseases and hospital admissions brought about by air pollution, using OHIP printouts. But Dr. Bates has been unable to translate this data to determine the additional cost to health services in Ontario as a result of air pollution.

L'Union des Producteurs Agricole du Québec has made representations to the House of Commons Special Committee on Acid Rain pointing out the acid rain damage to 1) maple sugar production and 2) tree growth in maple stands, but their figures are only rough estimates since no methodology to quantify the present and future economic impacts of acid rain have been developed.

We know that a switch from leaded to unleaded gasoline would be beneficial for a number of health, agriculture and forest related reasons, but we do not have at our fingertips estimates of the financial savings of such switch to convince provincial treasurers and finance ministers to make the necessary tax changes to equalize the price of leaded and unleaded gasoline to stop misfuelling.

Soon a decision will be made whether or not to build another nuclear energy plant, and we do not yet have the cost of nuclear waste disposal factored into the cost of electricity generated.

We know the climate is warming up and that certain parts of Canada will be affected, but we do not know the costs associated with such changes that would enable us to compare with the costs of trying to reverse the trend.

We know Lake Ontario's water suffers because of leaching of toxic chemicals from the dumpsites along the Niagara River. Yet we have not even started to calculate the cost of this damage for comparison with the costs to municipalities of installing complex and expensive water treatment plants, or of providing water from distant sources.

The easily calculable costs of proposed environmental protection measures, the use of discount rates and short-term cost benefit analysis, have all posed obstacles to the development and implementation of long-term environmental protection policies that would be in the long-term economic interest. This situation has stacked the deck in favour of short-term decisions. The "cost of inaction," if available, would become an important tool to decision-makers. Its absence is a serious drawback if we are to plan for sustainable development.

Resources have not been put behind the effort necessary to realize the impact of the cost of inaction. We need to develop a methodology, for policy advisors, policy developers, and policy makers. It is more than just a matter of political will in the conventional meaning of the phrase.

Let us hope that this symposium will get us going on the road to the identification and application of new economic tools which we badly need. They are of fundamental importance to present and future generations.

Chapter IV

Remarks at the Workshop on Cost of Inaction

Lars Osberg

One of the most interesting aspects of an interdisciplinary conference on environmental issues is the differences in perspective between people from different disciplinary backgrounds. The differences between disciplines are partly due to differences in language and academic jargon, but a more fundamental set of differences between disciplines center around the way environmental issues are perceived. Indeed, the theme of this conference is in itself an example of how the discussion can be framed. The title "Cost of Inaction" tends to presume that if no explicit action is taken, some social costs will necessarily result in the form of environmental degradation.

To those trained in the natural sciences, it may seem natural to view environmental issues as purely natural processes, which proceed without conscious behavioural change by any of the participants. In this vein, one can view the increasing ecological stress which an expanding world population and increased economic activity places on the environment as analogous to the unchecked multiplication of bacteria in a petri dish, spiralling out of control prior to the inevitable ecological collapse. Implicitly, this perspective assumes that the world is not characterized by social/economic/ecological systems with feedback loops that would self-correct tendencies to ecological destruction.

Although the biological literature contains many examples of natural species expanding beyond the carrying capacity of their environment and eventually crashing, I would argue that it is not quite accurate to draw analogies between such processes and those which involve the human species. Ecological disasters have, in some cases, extinguished historic human civilizations, and one cannot complacently assume that the environment will solve itself. However, there are also some clearly discernible tendencies in the social and economic systems of modern societies which tend to produce auto-correction in environmental degradation. It seems to me that the real issue for social and political thinkers about the environment is to identify, and attempt to magnify, the tendencies of human social and economic systems to the auto-correction of environmental crisis. A careful analysis of the processes which reduce environmental stress is likely to produce more benefit than cataclysmic proclamations of impending doom. To be specific, I have three examples of stress-reducing processes: economic, demographic, and socio/political.

If consumption of a non-renewable resource is increasing at an exponential rate, extrapolation of consumption trends will inevitably produce the result that the resource is absolutely depleted – usually in fairly short order. However, economists have argued for many years that simple extrapolation of past consumption trends ignores the feedback effects of the price system. As resources become increasingly scarce, they become increasingly expensive. The increasing relative price of resources creates incentives for individual economic agents to locate new supplies, develop substitute materials and economize on consumption. The price system may not do this optimally, and it may not act in time. However, the central point is that the depletion of resources cannot be accurately forecast by simple extrapolation of past trends.

Neither can one predict total population by simple extrapolation of past trends. The human species, taken as a whole, is increasing rapidly in size, but the birth rate in Canada is now approximately 1.7 per woman, substantially less than the rate required for zero population growth in the long term (and less than half the birth rate of Canadian women during the 1950s). Furthermore, declining birthrates are characteristic of developed economies. In the Third World, fertility declines are clearly associated with rising incomes, increasing urbanization of the population and especially with improvements in the relative position of women. Higher levels of female education, greater participation in the paid labour force and higher female earnings can have a dramatic effect in reducing the rate of population growth in poor countries. The population explosion represents a very real stress to the global environment but it is amenable to social processes.

Social processes in developed economies have also produced a noticeable improvement in environmental legislation in the last 20 years. And one can point to specific environmental improvements as a result: one no longer has killer smogs in London, fish swim again in the Thames River, emission controls are now standard on North American automobiles, etc. All these policies represent responses to perceived environmental crisis. Environmental impacts have been turned into crisis by some combination of media pressure and scientific evidence, spawning social and political movements and, eventually, legislation. Part of this process is the mobilization of expert opinion to an agreed course of action—such as this conference is attempting. Hence, in a very real sense one can view this conference itself as part of a feedback loop from environmental stress to the social policies which alleviate that stress.

In listing economic forces, demographic trends and environmental legislation it is not my desire to argue for complacency. There are clearly far too many examples of environmental disasters which have actually occurred. However, I do want to argue that one should attempt to learn from the small victories that have been won on environmental issues and use those lessons to encourage the tendencies in human societies to reduce environmental damage over time. And, in particular, the lessons I take from the above examples are: (1) that economic development is not the automatic enemy of the environment and (2) that changing social values are central to the environmental impact of economically developed societies.

It has been remarked that many natural processes (for example, soil erosion on the Canadian Prairies or the increased carbon dioxide content of the atmosphere) operate on a time scale very much longer than political processes, whose time horizons are largely determined by the electoral cycle, i.e., typically less than four years. However, societies differ fundamentally in the margin that exists to tolerate the expenditure required to reverse slow environmental degradation. Some societies simply cannot afford "short term pain for long term gain."

The affluence of developed societies means that they can afford the luxury of taking the long view. Resources exist to finance scientific research on subjects such as acid rain, or to fund computer simulations of environmental interactions or, indeed, to pay for gatherings like this. But there is much less disposable social surplus available in the Third World. Although there may be widespread awareness of environmental problems (e.g., the overgrazing of the African Savannah which contributes to the increasing desertification of many African countries), the agents of these problems often have no feasible alternative to their current behaviour. To be specific, Masai herdsmen may be well aware of the consequences of overgrazing, but

they have no other alternatives for grazing their cattle, and no reasonable alternative means of livelihood. More generally, in the Third World long-run environmental concerns have to compete with pressing immediate needs in public health, education and social services, as well as with the consumption aspirations of the elite and the hardware ambitions of the military. These competing demands are present, of course, in developed societies but with the crucial difference that resources are available to satisfy more of these competing needs.

In today's world, it is the richest countries which have the greatest ecological awareness and the most stringent environmental regulation. Poor countries are, on average, notable for their lack of attention to environmental issues. The lesson one can take is that economic development is not the enemy of the environment, rather economic development creates the resources which enable long-run environmental issues to be addressed.

But it is also true that the affluent nations of the world consume goods at a tremendous rate, while the poor are great recyclers. The richest 10 per cent of the world population consume approximately half of the world's production of goods and services each year (Berry 1983:222). Clearly, the affluent exert a disproportionate stress on the global environment. It is also observable that societies at approximately the same level of economic development differ significantly in the level of attention that is paid to environmental issues. In short, economic development may not be an automatic enemy of the environment, but it is not an automatic friend either.

What social trends in developed countries influence political institutions to establish legal regimes of regulation and pricing such that individuals and firms will have minimum adverse ecological impact? Underlying social values find their expression in legislation, which establishes incentives for individual behaviour, but the primary importance of social values is probably more direct. It is not just the fear of being fined for littering that stops individuals from littering. Rather, an internalized ethic which says that littering is bad prevents us from doing it, since most of the time we know that as a practical matter the probability of detection is nil.

The evolution of social values towards the environment is, I believe, central to our chances to avoid environmental disasters. But social values are generally diffuse and not always particularly logical. Most of us have several sets of values on hand, which we trot out on appropriate social occasions, without worrying particularly as to their overall logical consistency. Although untidy from a philosophical point of view, the incoherence of values does present the possibility for the environmental movement to emphasize those aspects of our common value systems which have positive ecological implications.

I would hazard the hypothesis that most of us have a concern for the welfare of future generations, not just our immediate progeny but also generations yet unborn. Why this is so is a deeper issue. It may be that we have an emotive identification with our own children, and realize that they will also care about their children, which gives us, by recursion, a concern with generations long in the future. Or it may be some more personal need to feel that all is not over on our own demise – that future generations will share some common experience with our own generation – which creates a concern with the very distant future. But whatever the reason, I believe that many environmental debates (e.g., concerning the disposal of high-level radio-active wastes) cannot really be understood unless we recognize the concern people feel for unborn generations.

Of course, this concern for unborn generations co-exists untidily in most people's minds with the immediate materialistic imperatives of a consumer society. I have argued elsewhere (Osberg 1985) that the welfare of society depends upon more than just the average consumption of its citizenry, since people also care about the uncertainty that attaches to their incomes. There are also good ethical reasons for a concern about economic inequality and about the bequest which this generation leaves for the benefits of future generations.

In part the bequest of this generation can be valued in money terms. The capital goods and public works which we leave behind have a money cost and our assets in these forms can be easily tabulated. Although evaluation of intellectual capital in the form of research and development or human capital in the form of education and training is more difficult, it is still possible. However, a major portion of our bequest to future generations is the quality of the environment which we leave behind. To the extent that we use the environment to produce income, we can assign a money value to our stands of forest, our ore bodies, or our stocks of fish, which represents the present value of such resources as an income source for the future. Evaluation of the more general environmental bequest of this generation in money terms is much more difficult. It is also, I believe, unnecessary if we recognize that part of our bequest lies in the form of the maintenance of a "national heritage."

In many primitive societies the concept of property in land is that of stewardship, in that productive land is conceived of as being held "in trust" by the current generation, who possess only circumscribed rights to the temporary use of the resource (Elias 1962). In these societies, the real owners of land are generations past, present, and future, a concept which we often refer to as our national heritage.

If we adopt, as part of the idea of a national heritage, the premise that certain aspects of the environment should be maintained intact

from generation to generation, then we can measure aspects of the environment (e.g., pollutant concentration in the Great Lakes) but we do not need to put a money value on such environmental aspects, since the national decision has been that they should not be sold. Like the family heirloom that has no explicit price because one would never want to sell it, it is both very difficult, and unnecessary, to set a price on heritage assets.

This approach to the evaluation of social cost would argue that we should establish estimates of the value of marketable assets which we bequeath to future generations and develop a national debate on just what exactly is the national heritage. By focusing the debate on what it is which we wish to preserve from the past, for the benefit of future generations, one would force people to think carefully about what it is which they wish to leave behind them. The debate on definition of a national heritage of environmental assets would provide a positive focus to environmental concerns and the measures necessary to implement them. And by emphasizing the stewardship responsibility of this generation, one would provide an ethical basis for the basic idea of a sustainable development of the world's resource.

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Chapter V

Going Global: A Canadian Initiative

Gail Ward Stewart

A new approach to the environmental issue is making it possible for all sectors to act together with common purpose. The process of familiarization with the new approach, and of exploring and developing the opportunities it reveals, is here called "going global." A going global process for Canadians, and for Canadian initiatives in the international sphere, is now under urgent consideration for development in the spring of 1986. This briefing paper has been prepared for interested individuals and organizations.

The Problem

It has been clear for some time that the environmental issue must soon move forward to take first place on the world's agenda. However, despite measurable public concern, the world's nations have been unable to formulate effective action, individually or collectively. The problem is often ascribed to a lack of political will of governments, greed of the private sector, or insensitivity to the environment, a moral shortcoming of the people generally. Public concern and frustration have mounted as the time passes without effective action and environmental conditions continue to deteriorate: desertification, soil loss, climate change, species extinction, the rapid disappearance of the rain forest.

Upon closer examination, the problem is not one for which any particular sector can be blamed. It appears to lie in several interacting factors, each of which must be addressed before effective action can be taken.

- Outmoded understandings of how the natural world works.
- The lack of a conceptual framework that situates the environment in its proper place in relation to human society and that can be used for practical decision making.
- The special characteristics of the issue itself as an issue for political action.

It now appears that sufficient progress has been made to make it possible to bring the environmental issue forward for immediate action, and in fresh terms.

A New Approach

For most of the human population, the natural world is understood in terms of its local geographies. Current scientific understandings would suggest that it is better appreciated, by people everywhere, as a single global process or field with an infinite number of participating elements and numerous particular local manifestations, interacting to form a complex geosphere/biosphere. The human species and its activities are understood as elements in these interacting processes, themselves a part of the "natural" global environment.

In our society we approach environment as though it existed outside ourselves, "out there," the environs. A new frame of thought ("new choice" theory) conceives the human species and its activities as situated within a pervasive global environment. In this approach, environment constitutes a context which needs to be taken into account at the point of origin of every human decision process. This provides a new intellectual perspective on our actions, a perspective consistent with current scientific understandings. It requires a mental revolution in our thinking, a process of reasoning from the global environment in, rather than from our own activities out. The perspective reveals many new opportunities for our future development.

In the politics of nation-states some issues are particularly difficult to bring onto the political agenda for action. The environmental issue shares this special character. The global environment can now be understood as "a commons." Economists might call such an entity a public good and it has that special quality of public goods: it is everybody's responsibility and nobody's particular responsibility (at least until responsibility for it is

assigned). Despite potentially fatal consequences, few are willing to act until everybody is prepared to act together. This is not irrational behaviour but arises from the character of the situation. The remedy, of course, is to take steps so that all may act together, and this process is now underway.

As it will be apparent by now, the several developments converge in a fresh way of looking at our situation and moving towards action. What is now needed can be specified:

- A network of persons from all sectors interested in addressing the environmental issue in new terms.
- A broad-based public process so that all may learn together a new way of thinking about the human situation and develop new criteria for appropriate decision making.
- A theme that identifies such activities so that they are recognizable from sector to sector and field to field.

The Environmental Issue Repositioned

The emerging global approach to the human situation has significant implications for government planning and for private sector planning in all respects: environmental, social, economic, political, scientific, technological, cultural, and educational.

Among other effects, the environmental issue itself becomes repositioned from problem to opportunity, from a matter of environmental illness to matter of environmental health, from an expense to remedy the past to an investment to improve the future, and from something that needs to be managed to something within which we manage ourselves.

An Initiative

The idea for a Canada-wide going global process is beginning to emerge, building on earlier initiatives of many kinds in many fields. It is fostered by joining and linking a variety of new initiatives with on-going activities in all sectors. Individuals and organizations are encouraged to take their own initiatives to develop going global processes: workshops, task forces, conferences and projects. It is suggested that these activities take place in conjunction with on-going activities, e.g., a going global session in an event already planned.

The going global process is fostered and explored by a small but growing number of individuals in a network linking environmental groups, the business community, the science community, political parties, community groups, associations of aboriginal peoples, other

groups and associations, e.g., school boards, health boards, active in a variety of endeavours at levels from the local to the national, and governments. A number of interested government departments and ministers and the Prime Minister's Office are aware of the initiative. Many governments and government departments already have responsibilities and programs consistent with the going global process.

A number of national initiatives to foster a Canadian going global process are now being discussed, as are a variety of international initiatives. Some specific initiatives under consideration include the following.

- A parliamentary committee on global environmental information. Beginning in the autumn of 1988 this committee would hold televised hearings, enabling Canadians to inform themselves on the current views of scientific experts about our global situation.
- The development of special access to the International Conference of Scientific Unions' International Geosphere/ Biosphere Program (the Global Change project), coordinated in Canada through the Royal Society of Canada, as a source of up-to-date scientific information for Canadians about the workings and condition of the Global Commons.
- A national task force or commission responsible for producing, with public input, and as quickly as possible (three years?) an environmentally-appropriate (environmentally friendly) social and economic development strategy for Canada, for discussion by Canadians and consideration by their governments and other organizations.
- A number of linked conferences at local, regional, provincial, national and international levels, repeated annually for several years, and including "bio-regional" groupings and national summits.
- The hosting of a global going global event, to include an international conference on how different nations are fostering the process in their own countries.
- New or renewed work on such concepts as state of the environment reports, environmental industries, environmental health, etc.

The time frame for making this initiative nation-wide is spring 1988, with a view to having Canada well along the way towards putting its own house in order with respect to addressing the environmental issue as a priority issue by the time of the Summit Meeting in Toronto in June.

A number of factors make it advantageous to pursue going global processes now, such as the probable urgency of the environmental situation itself, the participation of a growing number of Canadian scientists in the forthcoming international Global Change project which is being coordinated in Canada through a newly revitalized Royal Society of Canada, investments now being made in Canadian business, industry, science, technology, education, etc. (a change in thought about environmental considerations should be anticipated, as should the opportunities that will lie in the different perspective), concern that a national election could divert our attention and postpone action for a number of months, and the Summit Meeting itself with the opportunity that this provides to share information and develop cooperation on an international basis.

Chapter VI

Notes on the Address by Dr. Fraser Mustard, "Health as a Measure of the Cost of Inaction"

Michael Dence

There are a number of perspectives on health and health care which demonstrate the benefits of action to improve the general well-being of the population, the limits of traditional health care and the potential costs of inaction if emerging issues are not addressed.

1. The general improvement in the health of populations in developed countries over the last 150 years stems from improved nutrition. The data for TB and certain cancers (e.g., stomach cancer) show a steady decrease in death rate irrespective of specific medical advances.

2. Improved socio-economic conditions as humankind has moved from the agricultural revolution through the industrial revolution have led to changing values and standards of living. Rapid growth in population has resulted. However, in taking improved medical benefits to the developing nations, active intervention must be married to efforts to improve the socio-economic situation. Otherwise population growth, if unsupported, can lead to catastrophe.

3. Genetically, humans have a slow and limited capacity to adapt to change. There are limits to the improvements possible through

traditional medical care, which has been most successful in increasing the life expectancy of the very young.

4. The resulting changes in the patterns of disease and population put increased emphasis on genetic limits to age and increased health problems associated with age, such as dementia and hip fractures.

5. There are several aspects to the economics of health care.

   (i) National health records are not necessarily a direct function of expenditures. Japan and Sweden have substantially better records than the U.S. for much lower costs. Canada has consistently spent a smaller fraction of its GNP on health care than the U.S.

   (ii) An important component of health care is the informal medical care system. The formal health system will be swamped if informal systems continue to deteriorate.

   (iii) Mortality continues to correlate with economic and employment status.

   (iv) Change is difficult due to entrenched attitudes and professional opposition. The emphasis should be on total health care rather than on medical intervention.

6. Global problems will increase as the expectations of underdeveloped nations rise. Without attention to general socioeconomic well-being salvaging life alone will lead to famine and humans will increasingly degrade the environment. The choice will be between control of fertility by stress and famine or by more enlightened means. Unhappily, global agreement to control population growth is unlikely due to disparities in culture. The environmental impact of population growth will spin back on everyone, straining our capacity to adapt.

7. Political and social responses to such issues can be judged from the response to recognized environmental health problems. The leadership of the medical profession has been important in decreasing the incidence of smoking once critical scientific evidence became available. In the case of asbestos and lung disease, it took the realization that there were limits to medical treatment for action to take place. Now vested interests push changes in the use of asbestos.

To address both health and environmental issues on a national scale, the example of Sweden and the present approach of the Government of Ontario are models worthy of consideration. In Sweden, management and labour work together on the development

of legislation to create national goals. By sharing the financial and administrative burden, shared responsibility has replaced bureaucratic confrontation.

In Ontario, problems are being tackled by groups of citizens supported by the civil service which provides the data for analysis. By building such groups and improving the information base a thorough analysis of issues can be made and approaches debated.

Discussion of the address centred on the role of women in effecting improvements and cultural change. Resources spent on giving women a better education, an involvement in the labour force and a clearer sense of the future, particularly in the Third World, would be more effective than money spent directly on improving health care and the environment.

More generally, it was felt that arresting examples can be more effective than simply improved data in advancing issues. There is a need for greater innovation in asking questions, as there is more information in the existing data base than is used. Councils headed by first ministers can be highly effective if they can really focus on identifying and tackling problems, but there is naturally a limit to the extent to which first ministers can be involved. With profound changes coming, innovative organizational structures will be needed.

General Observations

Discussions commonly revolved around three points, enunciated in one workshop by Rod Dobell: what costs need to be considered, what are the problems in dealing with them, what are the criteria for defining objectives?

The third question raises the fundamental issue of whether the aggregate interests of the community are directed at preservation of the environment or at sustaining growth. This is a matter of values and ethics rather than of economics and simple questions of health and the environment. We can either strive to live in harmony with a changing environment or, through a growing body of knowledge, continue developments which will inevitably change the environment.

Without a conscious strategy, derived from intellectually respectable studies, responses by government will continue to differ from policy if support, and hence political will, are missing. Building a long-term international consensus will eventually harness public opinion and keep issues on the political agenda, despite changes in government.

Chapter VII

The Costs of Inaction: What Can and Should be Done and by Whom?

Jim MacNeill

Inaction or Action?

I would like to commend those responsible for the title of this conference. I have tested it on a number of people and they have all reacted with a smile that says "yes, that's what we should be getting at – the costs of failing to act."

But we need to remember that the costs we are paying now and will continue to pay are not the costs of inaction. On the contrary. If the World Commission's report, "Our Common Future,"[1] demonstrates anything, it demonstrates that depletion and destruction of the planet's basic environmental capital – its air, water, land, forests, species – are driven not only by private decisions but also by public policies, often backed by huge budgets – economic, finance and investment policies, energy, agricultural and industrial policies, development assistance, trade and foreign policies. In other words, the costs stem from action – from decisions deliberately taken – and they can be reduced or reversed only by action – other forms of decisions deliberately taken.

During the course of my remarks this morning, I will cite several examples of this taken from my experience with OECD and the Commission – and from what I might call "the cutting room floor." You'd be surprised at what has been left on the cutting room floor.

Unsustainable Agricultural Policies and Environment

One of the best examples comes from food and agriculture. Every year, agricultural and trade agencies fine-tune their policies to secure another increment of short-term gain in production and exports, without regard to their interlocked economic-environmental consequences. The agricultural subsidy structure of western governments encourages farmers to occupy marginal lands and to clear forests and woodlands essential for soil and water conservation. They induce farmers to over-use pesticides and fertilizers, to waste underground and surface waters for irrigation. They support farm practices which accelerate erosion and other forms of permanent degradation of the soil and water base.

The Sparrow report, "Canada's Eroding Future," stated that Canadian farmers were now losing over $1 billion a year in lost production stemming from reduced productivity resulting from practices that undermine their soil and water base – practices encouraged by subsidies.[2] Similar studies of the subsidy systems in place in the U.S. and other countries demonstrate the same thing.

These systems generate vast surpluses at great economic and ecological cost.[3] They also give rise to political pressures in North America and Europe that make it attractive to dump surpluses at subsidized prices in developing countries, and to raise trade barriers against imported food products in which developing countries have a clear comparative advantage. This supports pressures in developing countries which make it politically difficult for their governments to reform their own agricultural policies. As a result, large numbers of rural poor remain in marginal environments longer than they otherwise would, over-harvesting fuelwood stocks and grasslands, and stimulating the spread of deserts.

One cannot blame the farmers. Western agricultural policies, as the OECD has recently demonstrated, may be a babel of confusion, but farmers everywhere know how to read contradictory signals from governments. If they did not, they would not survive. In fact, those that cannot, do not. When it comes to deciding whether to graze marginal lands or to plant them to cash crops, for example, the subsidies provided by agricultural ministries, backed by multi-billion dollar budgets, provide them with far more powerful signals than do small grants for soil conservation provided by environment agencies. While constituency polls usually provide sufficient justification for the former, in some countries the latter must run the gauntlet of so-called benefit-cost analysis, in spite of the fact that this method of assessment is totally inappropriate for investment leading to irreversible depletion of essential capital, such as soils.

Virtually the entire food cycle in North America, Japan and Western Europe now attracts direct or indirect subsidies. According to OECD, the farm subsidy structure now costs western governments in excess of $100 billion a year. What conservation program can compete with that? Why should conservation programs have to compete with it?

These policies are not sustainable. We could change them as "Our Common Future" recommends. Agricultural and related trade and aid policies can be redesigned, and agricultural budgets, national and international, can be re-deployed in ways that not only maintain farm income – which is vital for sustainable agriculture – but also encourage farmers to adopt practices that enhance their essential soil and water base rather than deplete it. At the same time, overall burdens on public budgets can be greatly reduced. Assistance to developing countries can also be provided in ways that support essential domestic reforms to increase production and to reverse accelerating degradation of their resource base.

What should be done and by whom? I have mentioned a few things already. And the World Commission and, in Canada, the National Task Force on Environment and the Economy,[4] are quite clear about the bottom line.

Sustainability can be built into agricultural policies, but only by the agencies responsible for them. Conservation cannot be "added on" by some external body, divorced from the center of policy formulation. Governments should act immediately to make their agricultural, trade and aid agencies, and related international agencies like FAO, UNCTAD and GATT, responsible for the interlocked economic-environmental dimensions of their policies; and effective systems of monitoring and accountability should be devised to ensure that they live up to that responsibility. Now, that's a challenge for political science.

Who Pays, How and When? The Case of Acid Rain

Let me now turn to the question of who pays, how and when, and use another example close to home.

A few years ago, OECD focused a lot of its attention on measures to counter acid rain, on their costs and on their effects in terms of reduced damage.

We established – or, we thought we established – that the issue was no longer scientific uncertainty, although on this issue, as on so many other mega issues from climate change to chemicals in the environment, uncertainty will always be with us. Indeed, it will grow. Our survival depends on our ability to develop a capacity to make

decisions in the face of growing uncertainty. Another challenge for political science.

We established that the issue was not the technology of control. It exists.

We also concluded, and this may come as a surprise to you, that the issue was not the balance between the costs and benefits of control, although it is often so represented.

In 1981, we published a major report, "The Costs and Benefits of Sulphur Oxide Control."[5] Like all such reports, it was based on a number of assumptions concerning future energy use and fossil fuel consumption, which now look rather high, as well as assumptions concerning the damage costs of sulphur emissions, based on the then available evidence, which now look very low.

It really doesn't matter; our aim was to establish an acceptable method for such assessments, and you may be interested in the major finding of the report. It was that in the European member countries of OECD a 50% reduction in sulphur emissions by 1985 would require an estimated annual investment of $4.6 billion. That is a large sum of money, but it was exceeded by another sum—a very conservative estimate of the annual savings that would result—savings in the form of avoided damage costs to lake quality, to the productivity of fresh water ecosystems, and to crops and buildings.

The principal issue, and the main source of controversy, is who should bear the costs, how should the costs be borne, and when should the costs be borne? The other issues remain on the table, but they do so, in my view, largely because they offer politically acceptable ways to avoid addressing this one.

As to who should bear the costs, there really are not too many choices.

First, the costs may be borne by society at large, by people, property and ecosystems. Here they take the form of avoidable damage to land and buildings, to forests and lakes and, perhaps, to human health. On a world scale today, the costs are usually borne in this way, especially where the production concerned is located in one jurisdiction and the damage costs are borne in another.

Second, the costs may be borne by industry, if and when they are required to invest in the processes or technology available to reduce emissions. Competitive conditions permitting, a good part of these costs will be passed on to the consumers of electricity, or of steel, or of other goods, at least to the extent that they increase costs. In fact, they are often more efficient and reduce costs.

A third option is quite common in industrialized countries. The costs may be borne by the taxpayer subsidizing in whole or in part the research and development underlying the technology and, perhaps, even subsidizing the installation of it.

The point is that the costs will be borne by society and the economy; they cannot be avoided. They can be transferred between the public and private sector, between taxpayers and consumers, and to succeeding generations. But, sooner or later, they will be paid.

Just as we cannot escape the costs, neither can we escape the policy questions of who should bear the costs, how, and when?

In dealing with this issue in OECD, we quickly run up against the limits of analysis in shaping public policy. OECD's work suggests that the policies chosen to determine "who, how, and when" are critical in terms of cost effectiveness and in terms of impact on technological innovation, as well as on such factors as overall investment, inflation and employment. By and large, transferring costs to the consumer via the polluting industry – OECD's famous "polluter pays principle" – is preferable from the point of view of macro-economic efficiency.

But "who, how, and when" is seldom determined by analysis of economic and social benefits and costs, however systematic economists pretend that can be. The political temptation to rig the policy mix in favour of electors prior to the next election, or to continue to capture the benefits of an activity but transfer the damage costs to a neighbouring jurisdiction or, even more attractive – take nuclear, for example – to the succeeding generations, usually overwhelms any analysis.

These decisions, to the extent that they are explicit, are power driven, not analysis driven. If any analysis prevails, it is someone's analysis of the institutional and political, not the economic, benefits and costs. Fortunately, in Western societies, power is ultimately with the people.

Let me again draw on my experience for one brief example.

Anyone interested in the politics of acid rain should consider the sea change in the policy of the West German government that took place in June, 1982. The OECD study to which I just referred was completed and published in 1981, in spite of the vigorous opposition of Bonn. They sent their best government scientists, economists and policy analysts to our meetings to raise questions and doubts about all aspects of the study and, when that failed, to try to stop publication.

But, between 1981 and 1982, something profound occurred: the German people discovered what was happening to their forests. In their imagination – their collective mind's eye – they saw the consequences, the costs if you will, of continued inaction. The forests of Germany run deep in their culture, their poetry, literature, opera. Their favoured recreation is walking in the forest. It is almost as if the forests provide the habitat for the soul of the nation.

The body politic moved. In June, 1982, Gunther Baum, Minister of the Interior and head of the West German delegation to

the Stockholm Conference on Acidification of the Environment announced a 180-degree shift in the position of his government. And, within months German delegations to the EEC, ECE, OECD and other international bodies were in the lead, pressing for real action to reduce emissions. And the government itself took real action to reduce emissions, bringing in the highest standards in Europe.

I hesitate to add what I am now going to say, but I will anyway because I am still a little naive and it distressed me greatly at the time. It is that the same scientists, economists and officials who before June, 1982, accepted a brief to challenge action on the grounds of incomplete knowledge, inadequate assessment and scientific uncertainty, had no problems after June, 1982, turning these arguments on their head in support of the opposite brief. The difference was explained to me as the difference between a brief and a cause, but that left me wondering as much about their position after 1982 as it had about their earlier position.

In fairness, by 1982 some of the arguments were stronger. The 1981 OECD study did not place much weight on forest damage costs. Had it done so, the balance of benefits and costs would have been more favourable. Even more so if the analysis had included an assessment of the costs of the energy incentives deployed by most governments, subsidies of all kinds which actively encourage fossil fuel consumption, discourage efficiency and the development of alternatives. But energy is another area in which central planning agencies, energy ministries and power utilities are seldom held responsible and accountable for the effects of their policies on health, resources and the environment.

If the question of who should bear the costs and how are difficult, the question of when is even more so.

The economic answer to "when" is changing. In the past, the economists would have insisted on a rigorous benefit-cost analysis, with benefits discounted to present value. Many economists today recognize that discounting is inappropriate when applied to certain types of investments, including those that induce irreversible depletion of basic environmental and resource capital, or the transfer of costs to succeeding generations. There is need for a rigorous look at this whole question.

The political answer to "when" is also changing. There has been a measurable shift in the attitude of many leading corporate managers on these issues. In almost every industrial sector today, the companies that lead the competition are almost invariably those that have discovered energy and material efficiency and environmental efficiency. The result in macro terms has been a significant "dematerialization" of the economy. The leaders of these companies have begun to sense the meaning of "sustainable development" and

are adopting a different position. I have run into this increasingly since about 1980. Politicians listen to industrial leaders. They respect them and they represent power.

Another reason why the political answer is changing is the growth in the strength of the NGO movement – intellectual strength and "street" strength. I have spent most of my life making presentations to political masters – here, in OECD and elsewhere. And I have seen the strength of the NGO movement operate and effect decisions, often decisively.

In the past, the political answer to "when" was almost always "tomorrow." In some countries a few political leaders have become aware that, thanks to the rapid pace of change, tomorrow is catching up with today, even politically. Today's electors, certainly everyone under the age of 40 with a normal life expectancy, could suffer the costs of a Europe denuded of forests, coastal areas inundated by higher sea levels, temperatures 1-3 degrees higher at the equator and 3-5 degrees higher at these latitudes, and a planet with an impaired ozone shield. In western countries, with an open information system, electors are becoming aware of this and are demanding change. Look at the polls, among other indicators.

Even in the South there are signs of change, but there it stems more from a growing awareness among leaders of the impact of continued environmental destruction on their nation's potential for development.

The Return of the Famine

The big news for me in 1987 was not the Summit in Washington, but the return of the famine in Africa – in Ethiopia, Mozambique, Sudan and elsewhere. Unfortunately, I know of few examples that better illustrate the theme of this Conference. Thanks to generations of living off their environmental capital, these countries, and many others in Africa, Asia and Latin America, are now in deeper ecological debt than financial debt.

Forty years ago, Ethiopia, for example, had a 25 per cent forest cover; twelve years ago, it was down to 3 per cent; today, it may be 1 per cent. Seventy five years ago, India's forests covered over half the country. Today, they are down to 14 per cent – and going fast. In the tropics today, ten trees are being cut for every one planted; in Africa, the ratio is 29 to 1. During this year, 1988, the planet will lose another 20 million hectares of forest cover, an area nearly the size of the United Kingdom.

One result is the mass extinction of species now underway.[6] Tropical forests are inordinately rich in plant and animal species. The Smithsonian Institution's Tropical Research Institute has determined

that one square kilometer of one rain forest in one small country – Panama – contains more species than all of Britain. The extinction of these species not only deprives us of yet undiscovered medicines and foods but also dangerously reduces the genetic base upon which modern agriculture depends. Almost all of the food crops in the developed world – wheat, corn, soybeans, sorghum and rice – are derived from genetic stock from Africa, Asia and Latin America. Our ability to cross-breed for increased yields, resistance to pests and disease, is threatened by a reduction in this diversity.

Another result is widespread soil erosion and advancing deserts. It has been reckoned roughly that this loss of soil with its plant nutrients cuts Ethiopia's agricultural output by at least one million tons per year[7] – equivalent to two-thirds of all food relief shipped to the country in 1985. As trees disappear and sources of fuelwood go too, people turn to burning cattle dung and crop residues. When these materials are used as fuel instead of fertilizer, there is a further reduction in agricultural output. In Ethiopia, this was estimated at roughly $600 million a year, or about 30 per cent of the value added in their entire agricultural sector in 1985.[8]

In some areas there is a clear link between deforestation and loss of hydropower. Some 38 per cent of electricity comes from hydropower. But a recent World Bank survey of 200 major dams built in the past 45 years reveals that sedimentation, caused by soil runoff in the wake of deforestation, results in a 2% loss of storage capacity every year.[9]

All of this, and more, are the results of inaction, you may say? In the past, perhaps. Today, in developing countries as in our own, they are the results of action – the policy cupboard is full of incentives to cut forests.[10]

In Central America, if you own a patch of forest and you don't do anything with it, you are taxed for failing to "improve" it. If you log it, clear-cut it, slash-and-burn it, you are deemed to have served a socially useful function, and you get a tax break.[11] In Asia, government policies are ridden with hidden subsidies to foster faster cutting of the rainforests. In Indonesia, according to a report to the Commission, conventional accounting asserts that timber exports add $2 billion to GNP each year. A different appraisal suggests a net loss of $1.6 billion.[12]

Over-logging is a widespread problem throughout tropical forest countries. Export revenues are now worth $7.5 billion a year, yet they are projected to fall to only $2 billion by the year 2000, when a majority of present timber exporters are expected to become net importers.[13] As for other forms of exploitation, we find that in parts of Brazil, Colombia, Peru and Ecuador, cattle ranchers, many small-scale farmers and other settlers are actively encouraged, largely

through fiscal and tax incentives, to head for Amazonia and to establish their enterprises at the cost of the rain forest.[14] I well remember our hearing in Sao Paulo and our day with the Governor of Amazonia and his cabinet.

Coming back to the famine in Ethiopia, the growth of deserts has been logged by the scientific community for over 30 years. In 1977, following a long crisis, you may remember that we had an international conference on desertification. Governments adopted a plan of action and solemnly pledged to fund it. But, when that crisis was over, the plan was virtually forgotten and no funds came forth.

Then, the predicted happened in the Sahel: the drought, the ecological collapse, the famine. The cameras came and the world responded with an outpouring of generosity. Assistance poured in from so many sources and in so many forms that it was impossible to estimate the full cost of the relief measures. The best guesses put it well over $2 billion. Unfortunately, this relief, however generous, was too late for the millions who died, and much of it was wasted. In times of crisis, government strategies change from "ready, aim, fire," to "ready, fire, aim."

Suppose that governments had taken seriously their pledges to support the action plan to combat deserts. What would it have cost? According to UNEP, the plan called for an expenditure of $50 million a year for four years in Ethiopia or $108 million a year for four years in the eight countries of the Sahel.

The contrast in the numbers makes you wonder, doesn't it? Spending $100 million a year prior to the last famine to combat deserts – or prior to this one – would not have meant the end of famine. Nothing is that simple. But it could have reduced the risk and scale considerably. And it would have helped to put those countries on the path to more sustainable development.

Without these expenditures for sustainable development, we will have to commit increasing amounts to combating crisis – money that simply buys time for millions to survive and to postpone a very evil day. Survival for them depends on a capacity, which we don't now have, to sustain commitment after the crisis after the cameras have gone.

Change Perspectives on Environment and the Economy

What can and should be done? The most important insight of the Commission and of the Canadian National Task Force on Environment and the Economy is that we must change our perspective on the environment and the economy and recognize that the two have become one. The implications of that simple statement

are revolutionary but so are the relationships between the earth's environment and the world's economy.

We are now in a $13 trillion dollar global economy. Economic activity has increased 20-fold since 1900. The use of fossil fuels has grown by a factor of 30; industrial production by a factor of 50. And four-fifths of this growth has taken place in just 37 years, since 1950.

In 1987, we welcomed the 5-billionth member of the human family. In 1988 we will take another giant stride toward 10 or, perhaps, 14 billion, adding another 90 million. Most of these children will be added to desperately poor families in the Third World.

We must grow and grow fast if we are to meet the needs and aspirations of present and these future generations. The Commission estimated that a 5 to 10-fold increase in economic activity would be needed over the next half century. Growth on this scale is unprecedented and it cannot be sustained if it rests on the continuing depletion and drawdown of the earth's basic environmental capital.

Revise Systems of Accounting

What else should we do? I won't repeat all of the Commission's recommendations, many of which were picked up by the National Task Force and adapted to the Canadian scene. But let me mention another that relates to what I have been saying and to the theme of this conference.

If we are going to make sensible economic decisions in the future, we need to be able to measure, monitor, and report on changes in both the stock and quality of the nation's environmental resource assets. The Commission suggests that this should be a responsibility of ministries of finance and that such an evaluation of changes in the nation's environmental resource stocks should complement the traditional annual budget.

A New Conceptual Framework for Policy Analysis

If – I hope, when – we integrate environment and the economy, we will need a new conceptual framework for policy analysis.

It is one thing to look at air pollution, acid rain and climate change as separate and distinct problems, generating separate and distinct effects, the responsibility of separate and distinct bureaucracies. The result is one set of policies and programs for air pollution, another for acid rain and yet another for climate change. All of them focus on the effects and on ways and means to ameliorate the effects. And each separate action – banning or restricting the use of a chemical, adding a scrubber, replanting a forest – is tested against

its own separate risk analysis, cost-effectiveness analysis, benefit cost analysis, you name it.

It is quite another thing to look at air pollution, acid rain and climate change as interrelated issues, with a number of common sources in energy and industrial chemicals, and amenable to a common set of strategies involving certain energy policies, industrial policies, transportation policies, and even certain trade and aid policies.

It is quite another thing and it requires another framework for policy analysis. A few centres are working on this and some of their work looks very encouraging, but we need to focus a lot more effort on it and urgently.

A useful framework, of course, needs to be fairly comprehensive but still politically relevant.

It would not take economic and sectoral policies as a given and focus on, quote, environment policies, to ameliorate their effects. It would permit a display of all of the policy alternatives.

In the case of air pollution, acid rain and climate change, it would include alternatives in the area of energy, transportation, trade, and aid, for example. In the case of deforestation, species loss, soil erosion and desertification, it would include alternatives in the area of settlement, agriculture, energy, and again trade and aid.

It is often argued that we cannot afford the costs of action to reduce or reverse the damage costs of inaction. But that is simply not true. As "Our Common Future" spells out, the budgets are there, in all of these sectors, but they are now being deployed on policies that are ecologically blind and that cause much of the damage.

A useful policy analysis framework would examine the expenditures being made under these budgets and assess their impact on sustainable development, economically and ecologically. It would identify politically acceptable ways to redeploy these budgets, so that they support growth that is sustainable.

Change Institutions

It would be best, of course, if these new frameworks were developed and used by the institutions responsible for the decisions concerned – finance, trade and the sectoral agencies, as well as industry. That will require major changes in the way governments approach the management of both the environment and the economy, as recommended by the Commission and by the National Task Force.

If these recommendations are followed, it would be pretty revolutionary, even in an advanced country like Canada. They would require that proposals to cabinet be examined for the implications for sustainable development before they are submitted for approval.

They would require greatly increased participation in decision making by the private sector and by citizens. They would require that our resources be given a value before they are exploited, and not just after they are mined or cut.

Imagine, if you will, what this approach could mean for countries much poorer than ours, where the relationship between the environment and the economy might literally be one of life and death.

The first ministers have endorsed these recommendations in principle and, with that Canada has taken the lead in this critical area. I hope that Canada retains the lead by implementing these recommendations as quickly as possible. First, because we must in our own interests. Second, because Canada and just a few other like-minded nations are specially qualified to provide international leadership on environment and development.

Our leadership role would be greatly enhanced if we were seen to practice what we preach. Most developing countries are fed up being instructed by people from the developed world to do things that we would never have the nerve to do at home. To the extent that the federal and provincial governments succeed in implementing the recommendations of the National Task Force, Canada will be in an excellent position to lead by example and from experience.

Notes

1. World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, (1987)).

2. See, e.g., Myers, N., Emergent Aspects of Environment: A Creative Challenge, *The Environmentalist* (7, Number 3, 1987), pp. 163-174.

3. *Soil at Risk: Canada's Eroding Future* (Ottawa: A Report on Soil Conservation to the Senate of Canada, 1984).

4. WCED Advisory Panel on Food Security, Agriculture, Forestry and Environment, *Food Security* (London: Zed Books, 1987).

5. National Task Force on Environment and Economy, *Report of Canadian Council of Resource and Environment Ministers* (Ottawa: Canada 1987).

6. O.E.C.D., *The Costs and Benefits of Sulphur Oxide Control* (Paris: O.E.C.D., 1981).

7. D. Simberloff, "Are We On the Verge of a Mass Extinction in Tropical Rain Forests?", in *Dynamics of Extinction*, ed. by D. K. Elliott (Chicester: John Wiley and Sons, 1986).

8. K. Newcombe, *An Economic Justification for Rural Afforestation: The Case of Ethiopia* (Washington, D.C.: The World Bank, 1984). Quoted by Myers.

9. D.W. Pearce, *The Economics of Natural Resource Management: Issues Paper* (Washington, D.C.: The World Bank, 1986). Quoted by Meyers.

10. A. Sfeir-Younis, *Soil Conservation in Developing Countries*, (Washington, D.C.: The World Bank, 1986). Quoted by Myers.

11. R. Repetto, *Creating Incentives for Sustainable Forestry Development* (Washington, D.C.: World Resources Institute, 1985).

12. N. Myers, *The Primary Source: Tropical Forests and Our Future* (New York, and London: W.W. Norton, 1984).

13. R. Repetto, and M. Gillis, (eds.), *Public Policy and the Misuse of Forest Resources* (New York: Cambridge University Press, 1988).

14. World Resources Institute and World Bank, *Tropical Forests Action Plan* (Washington, D.C.: World Resources Institute and World Bank, 1985).

Chapter VIII

On Measuring the Cost of Inaction

Robert Hoffman

The measurement of social cost in monetary units requires the existence of a set of prices and a social discount rate that reflect societal values. In the context of measuring the cost of environmental degradation, market prices do not adequately reflect societal values. One approach to this problem is to internalize external costs in order to make market prices more appropriate;[1] an alternative approach, and the one developed in this paper, is to recognize the subjectivity of values and to engage the society directly in expressing values. In this approach, it is the role of the scientific community to determine a set of evolution paths that are deemed to be feasible from the perspective of scientific laws and the availability of technology; it is the role of the society, or at least the institutions delegated by society, to choose from among the feasible paths. The evolution paths may reflect varying degrees of sustainability,[2] environmental degradation, and economic development.

This paper proceeds by first identifying the characteristics of the socio-economic and ecological systems that must be considered in addressing the issues of environmental degradation and sustainability, and then by examining the implications of these characteristics for analytic methods. The "design approach" to socio-economic analysis is presented as an approach that may be appropriate for examining the sustainability of future evolution

paths. The design approach emerged from the research associated with the development of the Socio-Economic Resource Framework that was carried out at Statistics Canada and more recently at the University of Waterloo over the last ten years. In turn, the design approach has implications for data collection programs. These are discussed in the final section.

Nature of the Underlying System

Socio-economic and ecological systems may be characterized by their complexity, evolutionary nature, and externalities.

Complexity

These systems exhibit complexity in three ways. First, they are complex in composition, spanning a wide range of human activities and naturally occurring processes. Second, they are complex in structure in that there is a high degree of interdependence among the processes; as well, the relationships are often non-linear, involving thresholds and cumulative phenomena. Finally, they are complex in terms of their dynamics. Some processes operate very slowly, for example, those concerned with geologic transformations; others quickly, for example, certain chemical reactions and biological processes.

Evolutionary

Systems that are open to free energy and whose states may be far from thermal or chemical equilibrium, are evolutionary. When these systems are far from equilibrium, they may pass through a bifurcation or singularity from which emerges a new structure or a higher level of organization.[3] The emergent structure is not predictable from past states of the system, but will depend upon the learning accumulated by the agents within the system. In the words of Ervin Laszlo, "Evolution is always possibility, never destiny. Its course is logical and comprehensible, but it is not predetermined, and thus not predictable."[4]

Externalities

An externality occurs when the actions of one agent affect the well-being of a second agent without compensation. The agents may be remote from each other in both space and time. Clearly, the existence of externalities is a factor of major importance in environmental problems. The actions of one generation may very well affect the well-being of future generations just as the sulphur emissions associated

with production in one nation may adversely affect the well-being of another.

Implications

The characteristics of the underlying socio-economic and ecological systems have important implications for analytic methods, as does emphasis on the concept of sustainability as a desirable property of economic development.

The high degree of interdependence among human activities and ecological processes implies that partial analysis may not be legitimate because important feedbacks are apt to be neglected. As well, the concept of sustainability applies to the system as a whole not just to individual components. Put another way, the system as a whole can exhibit the property of sustainability even if some of its constituents do not.

Sustainability is a quality that is attributed to an evolution path; as such, it is fundamentally a dynamic concept. The impact of actions on sustainability, taken now, can only be judged in the context of an analysis that extends into the future. The time horizon must be long enough to encompass processes that are relatively slow moving and cumulative phenomena.

Because of non-linearities in the system and the relatively long time horizon of the analysis, extrapolative methods, with their emphasis on states and inertia, cannot be used.

The pervasiveness of externalities has a profound implication on analytic methods. The existence of externalities implies that individual welfare functions are not independent and therefore not additive. One individual may increase his level of well-being at the expense of another. The additivity of welfare functions is a necessary condition for market prices to reflect societal values.[5] If market prices do not reflect societal values, it follows that (a) there are no neutral or objective measures of value, (b) aggregation over space and time using value based weights is not legitimate, and (c) there are no objective criteria for choosing from among alternative evolution paths.

The Design Approach to Socio-Economic Modelling

The design approach to socio-economic modelling applies concepts from general systems theory and control theory to socio-economic analysis.[6] A design approach model consists of two components: a user who is a surrogate for the society of which the user is a member, and an open simulation framework that represents the processes of the system and their historical evolution. The user interacts with the

framework in order to increase his understanding of the system by exploring future alternative trajectories. Exploration is a learning process; the user learns through interaction with the modelling framework and, in turn, the learning is accumulated into the framework. Consequently, the user becomes an integral part of the system being represented as the source of novelty.

Design approach models are unlike most economic models which place the user outside the system. Such models presume that the future of the system is knowable to the extent that the model captures the laws of motion of the system. Traditional economic models are fundamentally deterministic in that the user cannot influence the future. The user is merely an observer.

In contrast, the design approach is based on the presumption that the future will be influenced by human actions. Actions reflect choices that are made on the basis of accumulated learning. Accordingly the future is, in principle, not knowable in that it is not possible to predict what has yet to be learned. The design approach is intended to support decision-making through enhanced understanding; it is not intended to predict or prescribe.

The concept of process is fundamental in the design approach; the observed states of a system are a manifestation of the underlying processes.[7] Two kinds of processes are distinguished: those that transform materials and energy and those that transform information. The former constitute the machine space of an economy; the latter the control space. The human-designed processes that inhabit machine space are coordinated through control space.

When processes are not properly coordinated, tensions may arise. It is the role of the model user to explore the various means of resolving tension and to provide the feedback which will assure consistency among machines. The process of identifying tensions and resolving them incorporates the experience, imagination, and learning abilities of the user. Tension is conducive to creativity.[8] Tensions arise when metaphors or theories contradict expectations; they result either in improved theories or in greater understanding and consequently refined expectations.

The strategy of representing processes or groups of processes as independently executable models with feedback through the user is a practical way of handling a large amount of compositional detail without resorting to linearity. The strategy of treating elements that change slowly as stocks and of keeping track of the evolution of stocks by means of stock/flow accounting identities gives rise to interesting dynamics and extends the time horizon of the analysis. Finally, the strategy of separating physical transformation processes serves to isolate values and makes it possible to approach the problem of externalities.

The Socio-Economic Resource Framework (SERF) is an application of the design approach to modelling. SERF represents about 250 processes that constitute the physical substrate of the Canadian economy. These processes are grouped into 43 independently executable submodels. They are linked so as to highlight tensions between the supply and disposition of labour and between the supply and disposition of energy and natural resources.[9,10]

Data Collection Programs

With the emphasis on processes and in the absence of a macro theory, there is a need for three kinds of data: data to quantify the relationships of process models (process data), data to count or measure the number of instantiations of each process (inventory data), and data to indicate historical including present states of the system (state data). Process data and inventory data are needed to represent the underlying system. State data is needed for calibration as well as for monitoring. It is desirable that parametric data be independent from state data. It is to be noted that, in general, parametric data cannot be inferred from state data for lack of degrees of freedom.

As well, it is evident that flows and stocks must be measured in physical units, rather than, or at least in addition to, value units. The currently accepted practice of deflating a time series of values, the product of prices and quantities, by an index of price change, as a surrogate for physical quantities is generally unacceptable. A constant dollar is an abstract concept; relationships among variables expressed in these units have no intuitive meaning and are not easily verified. Furthermore, this practice makes it difficult to represent principles of mass balance and the thermal and chemical laws governing physical transformations. The practice is particularly inappropriate for measuring stocks as the value of a stock is an artifact of accounting practice in that there are at least a half dozen different conventions for measuring their value in the absence of a market price.

Process Data

For processes that occur within artifacts that have been designed for the purposes of production, parametric data may be available from the process of design, for example, the engineering literature. In other instances it may be necessary to instrument a small sample of processes in order to estimate the needed parameters. What is needed is a data base of process descriptions. The feasibility of developing a

process data base was explored in the context of input-output type models.[11] For naturally occurring processes, parametric data must be drawn from the appropriate sciences.

Inventory Data

Measuring the instantiations of processes is simply a counting or inventory taking problem. There are a variety of methods for taking inventories of land, water, forests, and natural resources. Census methods are used to count people, families, dwellings, and household artifacts. However, apart from a few artifacts such as automobiles that must be registered, there are few systematic programs for counting stocks (in spite of the fact that we live in a society that is rich in artifacts). For example, there are few measures of productive capacity.

State Data

Most data collection programs are oriented toward state data; for example, programs to measure ambient environmental states, and programs of economic statistics. By themselves, these programs are only capable of supporting extrapolative analysis or comparative static analysis and as such they cannot provide an adequate base of understanding to support social decision making. As noted above, economic statistics programs tend to measure state variables in value units. However appropriate this information may be for macro-economic analysis its usefulness is limited for the purposes at hand.

From the discussion above, it is clear that existing systems of economic and environmental statistics are inadequate from the perspective of measuring the cost of inaction, especially if sustainability is to be an important criterion in making choices. The current emphasis on states and structure must be augmented by an emphasis on processes and inventories. Quantities must be distinct from values.

Notes

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Papers from the Waterloo Workshop

Chapter IX

The Brundtland Challenge: Background and Objectives Opening Address

Fred Roots

Why Are We Here?

We are here this morning primarily because we share a common concern.

That concern is expressed in different ways.

We have arrived at our opinions and concerns through different paths.

We have different knowledge bases, different experiences, and different responsibilities and capacities for action.

And I am sure that many of us have quite different ideas, different priorities about what should be done about the concerns we nevertheless share.

For most of us, concern about the state of the world, the environment, and what we are doing to ourselves and the planet Earth, is not a wholly new concern. It has been building subtly, in many quarters, over some time. But our concern is not about a long-standing problem that has been with us for centuries and which we have just recognized. What we face is a new series of events in the long story of the physical, chemical, and biological evolution of the planet, and a new problem in the history of the human race. The problem is new in scale, in complexity, in seriousness. It is a problem mainly of this century. But it is a problem that cannot continue unchanged into the next century. Whatever we do or don't do, will

have an influence on our future course as inhabitants of planet Earth. It is no longer possible – perhaps it never was possible – to do nothing. We have come here to discuss this common concern, and to share ideas on how we may best address this overwhelming problem.

I am not going to try to define at the outset just what are the elements of this problem. Jim MacNeill will do this, far better than I could, in a few minutes. But I will point out that despite our different perceptions, there is also common agreement that what we are discussing is in many respects the most important issue of our time. The situation we face marks perhaps the most important turning point in the course of the human race since the nearly simultaneous introduction of antiseptics (which made possible the population explosion) and of steel technology (which made possible steam engines, organized factory industry, mass distribution of food, and large scale resource exploitation). The new perspective that we are gaining about the role of humans in the workings of the planet is showing us that different threats or serious problems facing humankind – mass malnutrition or starvation, nuclear warfare, AIDS – are not separate issues, but all related to and integral with the problematique of environment and development on a regional and global scale.

A shared concern, a shared feeling of the enormous importance and urgency of the problems we face: to these is added the circumstance that recent events have provided an opportunity to explore our concern in a positive way; perhaps even to do something significant to ameliorate the problems and ease the concern.

All this is why we have come together. There can hardly be a stronger reason.

What Are The Objectives For This Meeting?

We have come together to explore the relations

- between economy, environment, and social behaviour;
- between human biology, human aspirations, and human institutions including technology, government, and information transfer;
- between the workings of the planet and the workings of the human social system, particularly as manifest in Canada;
- between the country of Canada and the nation of Canada.

And out of this we hope for nothing less than some well-thought-out, well-expressed, new and practical ideas that will help set Canada on a better course for the future.

This is very heady stuff. It is very fundamental stuff.

It is also very trivial stuff, as trivial as the fact that when we got up this morning, each of us probably took it for granted that there would be hot water when we turned on the hot water tap. Simple, trivial, yet for two-thirds of the human race such a convenience is unattainable and probably always will be. Also, it would most likely be considered by most of them a silly and needless luxury, using resources that, they feel, could better be spent in other ways.

But the issues we are dealing with, although trivial and commonplace to us today, are also as fundamental as the fact that most of us probably had some orange marmalade and some coffee for breakfast this morning; and it is most likely that none of us stopped to reflect on the environmental consequences. Most of us in this room know about the environmental implications of international trade; but did we pause to consider

- that if the oranges came from Arizona or California, our breakfast was exacerbating an impending major water problem?
- that if they came from Spain they were helping to deplete further an already impoverished soil?
- that if they came from Florida they could be helping to sustain a productive ecosystem by delaying the encroachment of black-top and high-rise onto fertile land, but that the short-lived fertility was probably made available by massive drainage schemes that destroyed an unique aquatic ecosystem?

Similarly with our morning coffee. Chances are that if the beans came from Colombia, they were from economically marginal but ecologically prosperous and sustainable farms; but if they were from Brazil, our morning brew was contributing to the imminence of a gigantic ecological collapse.

These examples, trivial and at the same time fundamental, are mentioned as illustrations that the daunting problems of achieving the sustained prosperity of the world that we are here to discuss are as commonplace as washing our faces in the morning and having breakfast.

They also show that if we want to do something about these enormous problems, we have to reach right into the system – a system that this very morning stretched from the breakfast table in Waterloo to California, Florida, Spain, and South America.

I think what we have come together for is to explore, with boldness, humility, and what realism we can, how we can reach into the system of human activities and institutions and tinker with it, get some control of it before the system of human activities breaks the system of planetary functions.

Background

The immediate background to our workshop is simple to describe.

When the United Nations General Assembly established the World Commission on Environment and Development, they gave expression at the highest international political level to widespread growing awareness of a serious and accelerating predicament that the human race was finding itself in. The predicament is an unusual one for a political and social concern, for it is seen to be independent of any particular economic system or political philosophy or structure. It affects all of humanity, although in different ways, regardless of the degree of social and economic development; yet it is precipitated and exacerbated by political, social and economic activities.

Dr. Brundtland's enquiry started from the political level and reached down literally to the grass roots in various parts of the world. The commissioners and their staff were able enough and diverse enough to get behind the superficial evidence – important though that is – and see what was really happening to world natural systems, to human needs and values, and to the institutions, governmental, educational, and cultural, that connect them.

The report of the World Commission on Environment and Development, "Our Common Future," says many things. It also carefully refrains from saying many other things. I will not comment on it in these introductory remarks before Jim has a chance to speak. What is important in this connection is that the enquiry and the report, commissioned by the highest intergovernmental agency in the world and addressed to all governments and all peoples of the world, forces the governments of all countries to do one of two things:

(i) Governments or the people can choose to disregard or trivialize the report. They can hope that the problems will go away, or be solved by the same market forces, technical ingenuity, and competitive ideologies that gave rise to the problems. This choice seems to turn a blind eye to the evidence of what is likely to be the future. The evidence suggests that in this case there will probably be not much of a future, and there very well may not be much future at all. (It was said that persons or countries who did not pay heed to history were bound to repeat it. How the world has changed: now, it appears that persons or countries who do not heed the lessons of history will not have a chance to have any more history, let alone repeat it.)

(ii) Governments can take steps, deliberately and openly and at several levels at the same time, to heed the recommendations and try to get control of the situation, can develop a strategy and action plan to get out of the predicament that the report describes.

Anyone who reads "Our Common Future" carefully and ponders on what it means for her or his country will conclude that there is no part-way point. A little change will not really do anything. A few easy-to-do small changes at the margins of the problems, while they might be encouraging, may be pointless or even counter-productive by giving the illusion of progress while allowing substantial matters to get worse. We either have to make some major changes, which may well be difficult and expensive in the short run; or else try to carry on more or less as at present, piling up greater environmental debts and passing our problems on to others for a while, hoping perhaps that we will be gone before the system collapses or that some new and presently unforeseeable development will correct things for us. A correction is bound to come about eventually, of course. But if we leave it to Nature, the direction of the solution and the end result may not be to the liking of most of human society, or of biological life. We have only to look at the other bodies of the solar system to see what may happen. The time is past when we can both abuse the planet and steer her as she goes, muddle through, and expect to survive.

Fortunately, Canada has taken the second choice, and intends to heed the recommendations of the WCED report. Our leaders have said this formally at every opportunity: at the United Nations General Assembly, in Parliament, in the Canadian Council of Resource and Environment Ministers, at first ministers' conferences. Just how this will be done is not yet clear. The Task Force on Economy and the Environment, established by the Canadian Council of Resource and Environment Ministers, is one bold and imaginative step to gear ourselves up to be in position to respond to the challenge. Some of the suggestions of the Task Force will require major, even radical changes in the Canadian system. To implement them will not be easy, even though provincial and federal ministers, leaders of industry, and citizens' groups have agreed that the changes should be made.

Despite our brave words and good intentions, there is a real danger that momentum will be lost in our usual jurisdictional bickering and decisional timidity. We might recall Stephen Leacock's comment that Canadians were passionate only about moderation. We must ensure that our passion for moderation in all things will not prevent us from making the important changes that are necessary. It is to be hoped that our discussions in the next two days will examine, in a practical way and some detail, what will be involved in making the changes in Canada from a generally destructive to a constructive way of living on our planet.

There is, however, a longer background to the events that have brought us to this workshop. The founding and early studies of the Club of Rome in the late 1960s gave early publicity to the "human

problematique;" the establishment of UNESCO with its last-minute inclusion of science together with education and culture inadvertently but irreversibly linked scientific knowledge with world awareness of the human condition; and above all, the United Nations Conference on the Human Environment in Stockholm in 1972. All of these, in the last 25 years, have set the stage for our discussions today. I took part in the Stockholm Conference and its preparation, and even after all these years it is exciting to think back and recall the intensity with which people from different countries and different economic systems discussed, almost for the first time, questions of the relation between economic development and environmental productivity, or whether a state had any obligation at all to refrain from damaging the environment of a neighbour. We have made enormous progress since then. The fact that the pronouncements from Stockholm, so radical at the time, seem mild or inadequate today, show how far we have come in our environmental expectations in less than two decades.

But in the sixteen years since the Stockholm Conference, world population has grown by 35 per cent. The population of some of the poorest countries has doubled. Our global production of food has nearly doubled, but the number of undernourished humans has increased alarmingly. Large areas in countries where people badly need food that were productive farmland when we met in Stockholm are now eroded ravines or barren desert, and have no hope of again becoming productive for many generations. Some things that then seemed so logical and attainable, like a world-wide Law of the Sea, have not yet been realized. Are we gaining or losing?

The Present Setting

There are three aspects of the background or setting to our discussions of the Brundtland report that are strikingly different from the background of the discussions at Stockholm Conference and the founding of UNESCO. These apply to Canada as to other parts of the world. One is the enormous advance of scientific knowledge and the change in scientific orientation in matters related to natural resources, environment, and human behaviour. Another is the rise of social environmental awareness and the institutionalization of environmental responsibility. The third is the widening gap between methods of making decisions in technologically advanced portions of society and the non-technological societies, between developed and non-developed countries, between the Stock Market and the Church.

Let us look briefly at what changes in each of these issues has meant to our discussion of the "human problematique."

Science

Since 1970, there have been enormous advances in the knowledge of the planet Earth and how it works. We have seen the bringing together of biological and physical sciences. New technologies, satellites, computers, gene splicing, etc., have led to a revolution in scientific thinking. The emphasis of understanding has shifted from analysis to synthesis. It is perhaps significant that this new awareness of the place of humans in the scheme of things started first with geophysics, with knowledge of the workings of the earth within the solar system. Earth was seen to be unique in many ways. It is the only planet we know of with a liquid surface. Of the thirty-odd bodies in the solar system of which we can observe the geological structure, only Earth and a moon of Jupiter, Callisto, seem to show signs of having undergone horizontal compressive forces. What is the cause of this uniqueness? Present speculation, admittedly roundabout, leads to the idea that biological life has played a key role in determining and maintaining the planet as we know it. It seems on present evidence, that earth is not intrinsically chemically or physically favourable for life, but that biological life maintains the planet in a condition favourable for life, and may even have given us the oceans, the composition of our atmosphere and the fold mountain systems.

Another realization widely accepted in the last 25 years is that biological evolution is not steady, but characterized by surges, stand stills, and crashes. Organic life has been nearly wiped out several times in the last two billion years, and there is no obvious basic reason why it should not happen again. What is the role and fate of humans in all this? By all biological evidence, as a species we are heading for a massive population crash. What could be done to avert it? By comparison with other species that have experienced population surges and crashes, food is not the critical factor: it is changes in reproductive behaviour or changes in habitat. And, without any doubt, the human species is undergoing profound changes in both these areas.

We are often fond of drawing attention to the profound changes that science and technology has made in our lives: in transport and communication, in the material standard of living for at least some of us, in the way we make war, in hot water in the morning and coffee on the breakfast tables all across Canada. We are less aware, perhaps, of how science and technology has made changes in the planet itself: in increased soil erosion, in the decrease of forests, the spreading of a film of oil over most of the world's oceans, and the accelerated extinction of many species of life. Some of the most important global changes brought about by changes in technology appear to be inadvertent and, so far, scarcely noticed, except by a few specialists. The introduction of steamship travel and, even more, intercontinental

aircraft travel has made possible the world-wide exchange of bacteria and viruses between all continents, with the result that the basic soil bacteria, distinctive to each region and continent only a century ago, are rapidly becoming globally harmonized. The consequences of this for biological productivity and evolution cannot yet be clearly seen, but may be profound. We are becoming accustomed to the idea of rapid world-wide spread of disease-causing viruses but when a new form appears, such as AIDS, which almost certainly could not have spread as it has without the aeroplane, we experience a response akin to panic.

Other kinds of problems brought about by the planetary response to human applications of science and technology are pervasive in nature, perhaps slower in initiation but likely to change living conditions for humans and other forms of life into the future. One such problem which is before us all today is the prospect of rapid change in climate due to increased concentration of "greenhouse gases," mainly CO_2 and CH_4, from the burning of fossil fuels and the widespread use of chemical fertilizers. The nature of the chemical reactions and energy changes involved are such that the effects, in changed climate and changed sea level, are very likely to persist long after we as a people have burned up most of the accessible petroleum supplies. So we, and all other living creatures, will probably have to adapt to the new conditions that science and technology have created for the future, conditions that, on the whole, promise to be less biologically productive and less environmentally benign than the conditions under which we now live. The irony of this situation is that if we could just stop cutting down our forests and regenerate them on a large scale, it appears, much of the climate change and consequent rapid sea level rise could be averted; another example of how apparently separate phenomena are linked through planetary processes and human intervention.

At the same time, with all these longer-term problems and changes brought about by the application of science and technology for short-term purposes, there has been emerging a new awareness and understanding of the inter-relationships that determine the state of the planet and the conditions that govern its habitability for humans or other forms of life. For the first time we are approaching a level of knowledge and sophistication that will allow us to attempt to understand, in a realistic way, how physical, chemical and biological elements combine to make us and our surroundings what they are today and how and why they are changing. Such insights have in the past been restricted to a few religious leaders and philosophers. Now it appears that we have the testable knowledge and scientific tools to subject the same profound subjects to vigorous observation, analysis, interpretation, and synthesis. This is a very heady and exciting

challenge intellectually, because it leads to a new kind of profound questioning of the basis of existence; and practically, because it deals directly with both the near-term and longer-term viability of our society, our economic and political institutions, and our civilization.

The clearest expression of the new ability and determination of science to investigate the human problematique and its relations to our planet is seen in the International Geosphere-Biosphere Program (IGBP), sometimes popularly called the Global Change study. The idea for IGBP has been growing in international scientific circles for the past eight years, and in 1986, after several preliminary studies, was formally endorsed by the International Council of Scientific Unions (ICSU) as its major co-ordinated activity for the next decade or more. IGBP has been called "the most important task that science has ever attempted." Its ambitious formal objective is nothing less than

> . . . to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human actions.

The international scientific organizations of ICSU, to which 57 countries belong, are supporting this program, and a large number of countries, including Canada, are establishing national committees and national research programmes for IGBP that will include both on-going studies such as those related, for example, to climate, and special authorities for data-gathering or inter-disciplinary research. A number of other on-going international studies, such as the World Climate Research Programme of the World Meteorological Organization and the World Ocean Climate Experiment of the International Oceanographic Commission, to name two, supplement the programme in their special fields.

The IGBP is examining earth processes and the manner in which humans, as important agents in changing the planet, affect those processes, but to maintain scientific objectivity as far as possible it is not human-centered, and is not designed to study the effect of global change on humans or their institutions. A number of other international scientific programs have been modified or launched to extend the IGBP findings into the human and institutional realm. Prominent among these are the UNESCO Man and the Biosphere Program, with research orientations designed to explore the management of damaged ecosystems, the relationship between human investment and resource use, and human response to environmental stress; the International Institute for Applied Systems Analysis, whose "Sustainable Development of the Biosphere" program

has studied the international policy implications of linkage between ecological and industrial systems; and the International Federation of Institutes of Advanced Study, whose "Human Response to Global Change Project" will undertake wide-ranging studies of the consequences that global changes may have for different cultures and societies. Many other national or regional studies of like nature are under way.

All of this activity on the science scene, and its popular and political spin-offs that range from concern about the "ozone hole" to biotechnology or the flight of Voyageur II toward Pluto, is giving both scientists and the world at large a new sense of perspective on the place of humans on the planet and in the universe. There is, I think, a new sense, based on knowledge rather than the gut intuition that has long been part of philosophy and cosmology, of the interweaving of all physical and biological activities, and a new awareness that the rates and scales of response and interactions may change more rapidly than we had heretofore assumed.

And yet this perspective brought by modern science is not really so new. As long ago as the sixteenth century the poet John Donne summed up this perspective when he wrote

> If a clod of earth be washed away by the sea, Europe is the less, as well as if a promontory were. Any man's death diminishes me, because I am part of the whole.

And in an often quoted but beautifully expressive passage, Chief Seattle of the Dwamish Nation on the Pacific Coast expressed the environmental wisdom of his people when he wrote in 1853 to President Franklin Pierce:

> What ever befalls the Earth befalls the sons of the Earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.

We all know this, instinctively and through personal observation, no matter how much we may ignore or deny it in our daily actions. Now we know its inevitability, perhaps more convincingly, through science, which allows us to predict, however poorly, some of the consequences of our actions. This awareness gives us a new sense of belonging, to each other and to our planet. When James Lovelock and his co-workers, on the basis of their chemical studies of planetary atmospheres and searches for signs of organic life on Mars, began to realize the essential one-ness of biological life and physical processes on our own planet, it was not a whim of poetic fancy but common sense that they should name their hypothesis Gaia, after

the oldest goddess of them all, the Greek goddess-mother of the earth, and the lady after which the science of geology and all its derivatives, and the very geosphere have been named.

It is not surprising, perhaps, that this new perspective on science of our planet came most clearly in recent years from studies of planets other than our own, for we often have to step away from our subject to see it clearly. What is surprising is that this simple idea, so new in modern science and yet so old in the history of the human race, should be embraced almost as a cult by those who grasp its essential truth but do not bother to think through its implications. It remains for scientists, policy-makers and opinion-leaders to understand and explain what Gaia means, and to help us all give the goddess-mother of the Earth the respect she deserves and indeed the sacrifices she demands if she is to nurture and protect us into the future.

Social awareness, institutionalization of environment

Another distinctive characteristic of the present setting in which we must find ways of achieving socio-economic development that can be sustained into the future is the rapid evolution of assigned responsibility for the condition of the environment. From a traditional view that Nature was a gift from Heaven and what happened to it mainly a concern of the Deity – "God sees the little sparrow fall" – there has been a gradual evolution of concern for the environment, through health and sanitation laws in the eighteenth and nineteenth centuries, and then early in this century through the conservation movements a widespread concern, within the affluent establishments of the wealthier countries, for the future of big game and for preservation of scenic wonders. To these developments we owe our first national parks, our geographical societies, our hunting laws, and the tradition of environmental citizens' groups. But the responsibility for what happened to environment and natural resources was taken to lie with individuals or with land owners, and it was to them that action was directed.

After about 1965 in most western developed countries a dramatic shift took place in public attitudes to the environment. The state of the environment, particularly pollution of the environment, became a popular concern and at the same time someone else's responsibility. The reasons for this sudden change are complex and fascinating, and cannot be explored here. But the result was that by the mid-1970s it was accepted in many countries to be a citizen's right to have a clean environment, prepared and delivered by the government. Between 1968 and 1978 about 150 governments, according to one estimate, created departments of environment or their equivalent, or added specific environmental protection responsibilities to existing institutions. Along with this development, however, in many

countries there grew a feeling that the individual was relatively powerless in matters having to do with the environment, and that the restraint exercised by the individual citizen against environmentally-damaging behaviour was ineffective against the pressures of consumerism, profit, and industrial competition. Environmental citizens' groups, formerly associations of people who enjoyed nature and tried to behave accordingly, changed to or were replaced by, groups aimed at political action. Environmental issues became confrontational, and in many respects surrogates for other subjects of dissatisfaction on industrial policy, regional development, or citizens' rights. Such developments forced, in many countries, an institutionalization of environmental responsibility and of the processes of environmental protection and natural resources management. In the event, they have made more difficult the incorporation into public understanding and into government structures at all levels the increasing knowledge and integrated understanding that was emerging from science at the same time.

In the early 1980s in both the Western countries and the Eastern bloc and also in many developing countries there has been another change in the institutionalization of environmental responsibility. The important environmental issues had moved from pollution, as an unwanted disturbance of an assumed pre-industrial "natural" situation, to wise use of all natural resources including soil, water and air, and were coming to encompass ideas about stewardship and responsibility for the environment in which future generations would live. In this situation, although accountable responsibility for the condition of the environment has remained with ministers of the environment, environmental issues have moved into, and behind, central political agenda in most countries. The nations' leaders are becoming spokespersons for environmental issues. We see evidence of this in the meetings of the Economic Summit, the Mulroney-Reagan talks on acid rain, almost all recent statements by General Secretary of the USSR Gorbachev, and in the speech by the Prime Minister of Japan to the U.S. Congress. The same thing is happening at national, provincial and local levels in many countries.

The idea of "environmental security" is gaining currency, although few will agree on what it means. It does indicate, as environmentalists have long argued should happen, that environmental concerns have become central government concerns, alongside economic growth and international relations. But this has not had quite the results some may have expected. Political leaders who espouse environmental causes must do so for political, not environmental reasons, even when the problems may not be of their making and the solutions not within their power or policy to achieve. And in some cases, without doubt, the politicization of environmental

issues at the highest level for short-term policy reasons makes more difficult the task of the minister of environment to achieve long-term solutions for the common good.

This is a new situation for the environmental citizens' groups, and so far they have not learned very well how to cope with it. For they are obliged to address issues of environmental sustainability and management of natural resources, both of which are long-term, on the same grounds as issues of military security, economic and regional development, and social welfare, which have quite different time frames. It is also a situation that, at present, is quite resistant to any findings of science which suggest the present course of industrial society may lead to many undesirable results unless some major changes are made.

Decision-making

A third aspect of the present situation, that we may find useful to bear in mind as we search for pathways to sustainable development, is the striking changes that are evident in the way that decisions are now being made in different sectors of our civilization about the fundamental things that affect our future and the future of our institutions. In the more stable societies of the past, no matter how diverse or contradictory or unfair they may have been, policy decisions were nearly all made by the state or the ruler, and individual decisions were guided by morals and principles defined by religion and the accepted mores of society. And most conscious decisions had a relatively local impact. Today, the policy decisions in most developed countries are rarely based on principle or on a conviction of right or wrong; but are a complex amalgam of information analysis, estimates of costs and benefits, readings of polls and likely public reactions, and guesses about what the others are deciding. And the impacts of such decisions are often far-reaching and quite different than intended, as our problematique shows. Frequently, the most important decisions are not made by those with major responsibility, but behind the scenes by junior staff who have only a limited area of knowledge or responsibility, who nevertheless define the issues and select and sort the information in such a way that those in power are presented with little real choice. The individual citizen, also, has come to rely less on his own judgement and become more dependent on the experts and information systems that he may feel, with good reasons, are manipulating him for economic or political gain. A distrust of one's sources of information and a feeling of powerlessness about being able to influence matters through one's own decisions leads easily to a vicious spiral of citizens expecting the government to make decisions for them and then mistrusting the decisions that are made. Most

western democracies, and many of the developing countries, are becoming caught in this spiral.

Today's decisions about the best paths for economic and social development and maintenance of environmental quality appear to be so complex that, in the absence of widely accepted moral principles guiding present behaviour and expectations for the future, a number of technological procedures for decision-making have come into use. Different kinds of systems analyses, futures studies, expert systems have developed to enable a larger number of factors and many more areas of expertise to be taken into consideration than could be assessed by even the most prodigious human intellect. These technical aids are essential for the operation of modern institutions and bureaucracy; but in thinking about ways to the future we must be aware that they lead to decisions that are information-driven rather than judgment-driven. Such modes of decision-making tend, almost inevitably, to lead to decisions that perpetuate the system that set them up. Such mechanisms can, of course, use simulation modelling to explore the consequences, in pre-selected limited areas, if one or another scenario of policies were to be projected into the future; and we will want to explore some of the more promising of these at this workshop. But the reliance, in even the most technically sophisticated countries and corporations, on catch phrases and slogans to represent complex political or economic paths of action, and the alacrity with which electors, countries, or multi-national businesses support a "true leader" and surge forward when one is found, demonstrate that even in the modern world the most effective decisions are made on the basis of judgement and emotion, not on rational analysis of information. The widespread acceptance of the Brundtland report, with its message of sober realism today and optimistic faith in the future without detailed analysis of the basis for that optimism, is an illustration of this. The achievement of a sustainable future must take into account this phenomenon.

One characteristic of the increasing interdependence of our modern world is that on a wide range of scales changes in environmental conditions affect people who have quite different response mechanisms and opportunities. Also, policies and the socio-economic and environmental consequences of the policies lead to stresses and issues to which people respond in different ways because they have different bases or systems for assessing the importance of the issues and for making their own decisions about them. Important examples of the increasing disparity in today's response systems are seen in the frequent frustration experienced when our overseas aid programmes do not have the results we had intended, or when United Nations or other international projects having to do with the global commons or human rights founder, not because of a fundamental

difference in goals but because the authorities and their ways of approving or negotiating are so different.

On both the international and the local scale, we are experiencing a dichotomy in our decision-making between the information-rich and the information-poor who rely on prior conviction or gut feeling, between the profit-driven analysis (the stock market decision approach) and the subjective decisions based on principle, religious conviction, emotion, sovereignty, or pride. If sustainable development is to be a real and lasting practical concept, the pathways to reach it must be supported by a wide range of different kinds of decisions.

The Future

Is the future of our civilization inevitably one of "ever-increasing environmental decay, poverty, and hardship for expanding populations in an ever-more polluted world of continually decreasing resources," as the challenge to the World Commission on Environment and Development drew one scenario?

The Brundtland report says very little about what precisely should be done to get ourselves out of the predicament in which we find ourselves, except to face up to the situation and to take resolute action at all levels to change our obviously self-destructive way of living with each other and on the planet. Jim MacNeill will have more to say about this.

But, in truth, most of the things that ought to be done are obvious and common-sense and have been enunciated since the writings of Moses, Aristotle, and Confucius. But how to do it, how to persuade human society collectively and institutionally, and human beings individually, to find greater present satisfaction in short-term restraint for long-term benefit, is a problem that has been with us for centuries but has achieved new importance and urgency within our own generation.

Most herd animals of other highly organized species, and many primitive human societies, have evolved elaborate codes of behaviour or taboos that serve to protect the community from over-exploitation of its resources or to reduce its vulnerability to environmental change or other imposed impact. Can modern humans, with much greater knowledge of actions and their consequences, who pride themselves on having broken free of many restraining taboos that controlled our ancestors even though we all seem to retain the same predatory and procreative instincts, and who have so many new options for action, achieve a collective behaviour that is within the physical and biological limits of the planetary environment? That is the root question before us. Although the form may differ, the question is not

so very different in a country like Canada with a high energy and materials consumption and a net birth rate below replacement level, than it is in a country like Bangladesh with one-tenth the energy consumption per capita and ten times the birth rate. In each case, the thinking people in society know what must be done to achieve sustainability. The trick is to match what ought to be done with what can be done in the next few decades.

In all discussions of this kind, two schools of thought generally emerge. There is what might be called the ruthless school: we must get human biology under control, get control of the population surge, get rid of impractical ideas of equity for the unfit and compassion for the weak, let the fit survive and the quality of life will improve for all. Although they probably did not intend it that way, Moses, Adam Smith and Darwin have contributed to this line of thought. And then there is what might be called the benign school, which places emphasis on fairness, distribution of knowledge, goodness and wealth, on inner satisfaction through renouncing of competition and personal ambition, including control of the pleasures of the flesh for the common good. Buddha, Confucius, Francis of Assisi perhaps exemplify this school, picked up by many "alternative" movements in the modern context. Several thousand years of history have shown that both approaches have a powerful hold on human society. Both have been biologically and environmentally successful in the past, on a small scale. It is fascinating to watch them evolve today, when the problems are of a global scale, and are mixed up with the fact that environmental issues are a part simultaneously of world politics, international economics, and of the generation gap within our society.

What We Should Do At This Workshop

This is a time of unique opportunity for us in Canada to be exploring pathways for sustainable development. The release of the Brundtland report, in which Canada played a conspicuous role, and our forthright national follow-up through the CCREM Task Force on Environment and Economy whose recommendations were endorsed in principle by the First Ministers' Conference, gives us a tremendous head start which few other nations can equal. The Montreal Protocol on substances which can damage the ozone layer associates Canada forever with one of the first successful international attempts to be prudent and forward-looking in our management of the global environment. And other international events in the coming year will further focus world attention on Canada as a place where hard thinking and serious negotiation is taking place on subjects that have to do with the future and its sustainability. At the Economic Summit, and the International Conference on the Changing Atmosphere and

its Implications for Global Security, in June, we will have a rare opportunity to explore ideas that will make these discussions truly constructive. I know that the results of our deliberations at this workshop will be looked at with interest by those taking part in these international meetings.

In the next two days, we should look hard and critically at major areas where issues raised by the World Commission on Environment and Development have implications for Canada, and for Canada's role in the community of nations. We should ask these questions:

- In what way do present models of economic management and decision-making, which have led us into our present predicament, need to be changed to lead us out of it?
- How, or in what way, do Canadians need to change their expectations as private citizens?
- If we change our expectations, how do we change our private and institutional behaviour?
- Does our basic value system really need to change, or do we, in fact, need to return to it?
- What new options or ways of doing things can be opened to achieve a new and longer-term perspective, to increase the sense of belonging to the planet and to each other, to take responsibility for the future in a practical, hard-headed way?

The present condition that we find ourselves in was aptly captured nearly two hundred years ago by Robert Burns, when he was ploughing a field and accidentally destroyed a mouse's nest, and reflected:

> I'm truly sorry Man's dominion
> Has broken Nature's social Union,
> And justifies that ill opinion
> That makes thee startle
> At me, thy poor Earth-bound companion
> And fellow mortal.

What we have to try to do, what we must do, is to re-establish Nature's social union, by re-arranging Man's dominion in harmony with all other Earth-bound companions and fellow mortals.

Chapter X

The Challenge of "Our Common Future"

Jim MacNeill

First of all I would like to express my deep appreciation for your invitation to address this distinguished conference and to commend the organizers, in particular the University of Waterloo, for bringing us all together. They have asked me to speak once more about my favorite subject, "Our Common Future," sensing perhaps that while I may have exhausted you, I had not exhausted myself when I spoke at the Cost of Inaction Conference in Ottawa.

It was a year ago, almost to the day, in Tokyo that the World Commission on Environment and Development reached agreement on the text of "Our Common Future."[1] We had started 900 days earlier in Geneva – 22 almost complete strangers, political and industrial leaders, scientists and diplomats, representing every shade of political ideology, from every region of the world, and with a strong majority from developing countries. We began with almost total disagreement on most of the issues. We ended with a full consensus on a diagnosis of the issues, and on an agenda for change to manage the growing risks and the immense opportunities challenging the world community.

This morning I would like to discuss two of the main themes of the report: sustainable development and the integration of environment and the economy. Sustainable development may be a new model for economic growth. I discussed this in my talk to the Cost of Inaction Conference: how many of our presently unsustainable policies, many

supported by massive public subsidies, could be turned around. I will not repeat that this morning.

The transition to sustainable development, as the Commission saw it, demands the integration of environment and economy in our institutions. It raises some profound, if not new, issues of governance. President Wright mentioned two in his words of welcome: there are no institutional or political systems with the required credibility, and there is no constituency for the future.

This morning I wish to elaborate on these and other problems of governance raised by sustainable development. They require decisions about institutions and forms of decision making that are fundamentally political. And the bottom-line question is whether the changes are within, or can be brought within, the realm of political reality.

A Global Enquiry

Between Geneva and Tokyo, we conducted a global enquiry into the critical and interlocked issues of environment and development. We did all of the normal things you would expect of a commission of enquiry. We commissioned expert papers, established high level panels, heard from distinguished world figures. But we also did something quite unique – we conducted public hearings in Latin America, Asia, Africa, Europe, and the Soviet Union. We had a 10-day series of public hearings across Canada in which some of you participated.

We released the report in London last April and presented it to the United Nations on October 19 in a special plenary debate. When the debate was scheduled we did not know that October 19th was to become better known as "Black Monday," the day the New York Stock Exchange dropped by 502 points. That knocked us off the front pages, but it also underscored dramatically a recurring theme in the report: the need for some fundamental changes in the way we manage the planet.

Prime Minister Gro Harlem Brundtland presented our recommendations. The Secretary General, Prime Ministers Ghandi and Mugabe, and many other political leaders spoke. The Hon. Tom McMillan led a large delegation, including provincial ministers and corporate leaders.

The dramatic highlight of the debate for me was provided by the president of the small island nation of the Maldives. He galvanized the Assembly with a plea for action to prevent the physical disappearance of his nation.

The highest point in the Maldives is less than two meters above sea level. Most of the 1190-island nation is below one meter. I

recently returned from an international meeting on climate change in Italy, having learned that a sea level rise of up to one and one-half meters within the next 30 to 40 years is highly probable, according to the scientists closest to this issue.

To endangered species, we have now added a new category – endangered nations. The most densely populated and richest parts of many nations are on a fast countdown to extinction unless preventive measures are taken. Given the inertia of the physical systems involved, and the time lags in the political systems involved, those measures must be initiated now.

A Critical Cycle of Parliaments

At the press conference in London following the launch of our report, Prime Minister Brundtland was asked what was the most important word in the report. I thought she would say "sustainable development" but that is two words. Instead, she answered "the most important word in 'Our Common Future' is 'now'; we must act now."

Canada may be electing a new parliament this year. The U.S. will be electing a new president and congress. Many other countries will be electing, or otherwise selecting, one or both over the next few years.

Some hard decisions need to be taken during the four- to five-year lifecycle of these parliaments.

We need action now, for example, to reduce the avoidable waste of fossil fuels and the release of certain chemicals in the atmosphere, which are the primary source of growing air pollution, acidification of the environment and, now, catastrophic climate change.

We need action now to change certain trade, agricultural, forestry, industry and other policies, which are the main cause of the spread of deserts, the loss of forests and the accelerating extinction of millions of plant and animal species.

And we need action now to change some other economic policies which are the source of growing risks to the environment, and to the high levels of economic development necessary to provide employment and meet the basic needs and aspirations of the 5 billion now here – and the 5 billion who will be joining us all too soon.

The good news is that if these decisions are taken, we cannot prevent but we can at least reduce the scale of some catastrophic changes now in the pipeline, as well as a potentially massive decline in the capacity of the planet to support economic and social development, a decline that will test the limits of human survival.

The bad news is that if these decisions are postponed to the next cycle of parliaments, or the cycle beyond that, human society faces the

most intense challenge to adapt to massive change it has ever confronted.

The decisions needed now are politically difficult. If they were not, they would have been taken a long time ago.

They cannot be taken by ministers of environment. Their decisions are usually focused on the effects of development, health, property and ecosystem effects, and on reactive measures to deal with damage already done, measures to retrofit, re-build, replant, restore, reclaim, rehabilitate. These decisions are important and, given the trends, will become even more important to our potential for development and survival. But they are not the decisions necessary for change.

No, the decisions needed now to turn this around must be taken by ministers of finance, energy, agriculture, trade and so on, and by leaders of industry and science. In no country today have these ministers, whose policies are usually at the source of the accelerating drawdown of our environmental resource capital, been given any responsibility to take the sustainability of environmental resources into account. Nor are they ever held accountable politically for the impact of their policies and budgets on the sustainability of environmental resources. Both responsibility and accountability usually ends up on the shoulders of the poor and comparatively powerless minister of environment. Not an enviable position. Nor, given the imbalance of power and resources, a particularly hopeful one.

The Commission made a number of far-reaching recommendations in this regard, aimed at international and regional organizations, governments, industry and NGOs. The National Task Force on Environment and Economy, made up of ministers from seven governments, federal and provincial, and the CEOs of seven of Canada's top corporations, took our recommendations and adapted them to the Canadian scene in a far-reaching, landmark report.[2] That report was recently endorsed by the first ministers.

The Commission's Assessment

Let me try to capture the Commission's assessment in five brief points.

First, our future survival is threatened, both as a world community of nations and as a species.

Second, the pressures on resources and the environment which have generated these threats are bound to accelerate and, even if we start to act now, they are bound to get worse before they begin to get better. It is true that we are winning some significant battles, the Montreal Protocol on Ozone is perhaps the latest example, but we are losing the wars. You are familiar with the depressing trends, I am

sure, and I will not repeat them here today. Suffice to say that we are losing ground on just about every front: forests, species, soils, debts, deserts, famine, ecological refugees, water, chemicals, acidification, ozone and man-made climate change. In face of this, governments are reducing, not increasing relevant research and action budgets, re-enforcing the march of folly.

Third, the means and experience exist to turn this around. We know, for example, how to gain 50 to 100 years on climate change, without sacrificing growth, deploying policies that have already been tested, and increasing macroeconomic efficiency. In fact, a number of trends and an enormous range of scientific and technological advances suggest that, with a little luck, we could turn the next century into a glorious renaissance, based on a cleaning and greening of the planet – and a greening of economics. That's what "Our Common Future" is all about.

Fourth, the main source of these threats is to be found in a wide range of narrowly conceived economic, trade, energy, agriculture, industry and other policies, national and international, policies which systematically discount the future.

Fifth, underlying these policies are institutions that are today held neither responsible nor accountable for the net results of their decisions. They are largely unaware of, and unresponsive to, the interlocked environment-economic dimensions of development.

Sustainable Development

The main political concept of the report, the one that has caught the eye of governments, industrialists, scientists and others around the world, is sustainable development, that is, development which is both economically and ecologically sustainable. The two are inseparable.

Growth on the scale required to meet the needs and aspirations of 8 to 14 billion people over the next 30 to 100 years will entail a further rapid expansion of the world economy by as much as 5 to 10 times over the next 50 years on the present base. Energy use alone would have to increase by a factor of eight just to bring developing countries, with their present populations, up to the level now prevailing in the industrial world. Similar factors could be cited for food, water, shelter, and the other essentials of life.

The U.S. member of the Commission was Bill Ruckelshaus, a Republican, once Attorney General, once head of the FBI, twice head of the US Environmental Protection Agency. He put it very clearly in a speech in Denver recently when he said that the trends are a clear warning that "the survival of this planet as a decent home for all who share it depends on us making profound changes in the way we do business." "Doing business," he defines as "the way we extract

material from nature, add value to it by industrial processes, and bring it to market."

"Our Common Future" is a political document. Major economic journals and leaders in government and in the corporate, scientific and non-governmental world have called it the most hopeful and useful report on environment and development to appear in two decades. It is full of suggestions on how to achieve sustainable development in the fields of international economic relations, energy, industry, agriculture, the management of the global commons, even new concepts of security.

Institutional Change: The Key Imperative

The greatest single barrier to sustainable development is the way in which we have traditionally organized our institutions. Unfortunately, our institutions, the forces behind them and the culture within them, are most difficult to change.

There are several problems, some of them very deep-seated.

I mentioned one in my talk to the Costs of Inaction Conference. Our institutions find it politically difficult, often impossible, to address the principal question of environmental management: who should bear the costs, how should they be borne, and when should they be borne? There is nothing quite so interesting, or depressing, as watching a group of political representatives around a table at OECD or the UN tailor the ancient ways of dodging this question to the issue at hand.

This problem may stem from, and is certainly aggravated by, forces both inside and outside our institutions that compel them to seek every conceivable means to achieve two things: first, to capture the benefits of an economic activity, the jobs, the income, the profits, the tax revenues, for today's electors; and, second, to transfer the costs of managing the wastes from that activity to somebody else. This is not ideological. It is as true in Eastern as in Western Europe, and in South as in North America.

The somebody else is often a neighbouring community. You have all heard of the "Not In My BackYard" syndrome – NIMBY, for short. Ontario has a bad case of that political disease. Unfortunately, so do most other jurisdictions.

When an entire nation catches NIMBY, the aggregate result is what I call NIMNY, the "Not In My Nation's Yard" syndrome. Every industrialized nation has caught this disease and it is spreading throughout the world like a plague.

Nations with these diseases try to transfer costs to a neighbouring country or to the global commons – the oceans, the atmosphere and outer space. Strong countries transfer the costs to weak

ones. And politicians daily face the irresistible temptation to transfer costs to the weakest group of all – future generations.

This is planetary management on the pay-later plan. The problem with this plan is that tomorrow has caught up with today. The future generation in this calculus is already with us. On a global plane, 50 per cent of the population, more than 2.5 billion people, are under the age of 25. They are the "new majority." They do not have the option that earlier generations had and that the politics of our institutions dictate. They will not be able to pass these costs on to later generations. The swift pace of change has eliminated that option. Millions of them are becoming aware of the issues and, as our political institutions are beginning to discover, they vote.

Integration of Environment and Economy

The essential problem is that the world's economy is now totally interlocked with the Earth's ecology, but our institutions are not.

In the late '60s and throughout the '70s, when we were building our institutions, environment was viewed largely as an "add-on" to development, seldom as an integral "build-in." The mind-set of professional economists saw the environmental costs of development as "external" to development, to be dealt with by measures external to development. This mind-set was pervasive and it became reflected in add-on institutions, promoting add-on policies, often requiring add-on technologies. Underlying all of these add-ons – and more important than any of them – was the early but slowly changing view that environment is also an add-on politically.

By and large, national environmental protection and resource management agencies, as well as international agencies, such as UNEP, have tried to do the best job possible, within the limits of their mandates and limited budgets. But nowhere have they been able to keep up with environmental degradation.

And, in retrospect, it is unreasonable to have expected that they would. The central economic and key sectoral agencies of government, with their enormous policy and budgetary power, were and remain in a position to encourage forms of development that generate negative effects on resources and the environment at rates far in excess of the capacity of environmental and resource management agencies to deal with those effects.

The Commission proposes several directions for change in these arrangements.

Clearly, we must strengthen our environmental protection and resource management agencies, both national and international, and multiply our spending on retrofitting, restoration and rehabilitation.

The report contains a large number of specific recommendations in this regard.

The most urgent task, however, is to make sustainable development the overriding goal of all government agencies, national as well as international, including the entire UN system. Central economic, trade, and sectoral agencies must be made directly responsible for ensuring that their policies, and the budgets they command, encourage development that is sustainable, ecologically and economically.

Then, they should be held accountable for doing it.

Responsibility

The task of securing an integration of environment and economics in our institutions, in any formal sense, will not be easy. But it can be done.

The formal mandate of the UN Secretary General, UN agencies, the World Bank, the regional banks and other regional organizations, can be changed, as the Commission recommends.

At the national level, ministries of finance, energy, agriculture and other sectors can be made formally responsible for the impact of their budgets on the sustainability of the nation's environmental resource base. Corporations can similarly bring these questions into their board rooms.

Processes of decision-making can also be changed in a formal way. The Task Force, for example, recommended that all submissions to Cabinet include a section demonstrating that any measures proposed would encourage development that is sustainable.

These things can be done. They won't be easy to effect, but in the ten months since "Our Common Future" appeared, there have been a number of encouraging developments.

I mentioned the General Assembly debate. The resolution adopted by the Assembly, while necessarily general, endorses the principle directions for institutional change recommended by the Commission. It calls for some action now and further consideration of our recommendations at the next session of the General Assembly.

The World Bank is re-organizing and greatly enhancing its environmental department to enable it to better assess investment proposals against sustainability criteria. Some regional banks and several development assistance agencies, including CIDA, are taking other measures to the same end.

A number of governments are undertaking a systematic assessment of our proposals for change. I mentioned that the National Task Force report had been endorsed by the first ministers. It would require major changes in the way Canadian governments and

industry approach the management of both the environment and the economy.

All of these things and more are essential if the environment and the economy are to be integrated in decision-making. But they are not sufficient.

Accountability

The question of how best to change, in a formal sense, the responsibilities and decision-processes of our major economic institutions is difficult. But the much more difficult question is this: having changed their formal mandates, how can society hold these institutions accountable?

The Commission and its panels were made up largely of people with a strong political background and they tackled this question from several angles. In the end, they made a number of recommendations that would at least increase the potential for accountability. So far they have not received the attention they deserve, perhaps because they are not comprehensive.

A number would involve changes in national and international law. For example, the Commission proposed that the General Assembly initiate negotiations on a new international charter for environment and sustainable development. Among other things, such a charter would prescribe new norms to guide state and interstate behaviour in our global village. These norms would include, for example, prior notification to neighboring states of activities likely to have an impact on them, as well as agreement to exchange information and consult on request. Even after Chernobyl, the member states of IAEA were not prepared to go that far. They agreed that states had an obligation to alert and inform neighbouring states, but only after an accident has taken place that is likely to have a harmful impact on their environment.

As I mentioned earlier, local communities and nation states can and do seek to transfer the environmental costs of economic activity to somebody else. Two of these "somebody elses" are without any effective means of representation in our national and international institutions. I am referring to the global commons and future generations.

In a world in which decisions reflect a balance of power between interests, who should be responsible for assessing the implications of policies and projects on behalf of the global commons and future generations? A charter on environment and sustainable development should address this question. One interesting idea that was explored at some length would involve the appointment of an environmental ombudsman by governments and by the General Assembly. He or she

would receive briefs and submissions from governments, industries, institutes, NGOs and citizens. Enjoying an independent capacity for assessment, the ombudsman would report periodically to the people of his or her jurisdiction – local, national, global. I suggest that the annual report of a Canadian Environmental Watchdog would be at least as interesting as that of the Auditor General.

Our Legal Panel, which met at the World Court in the Hague and benefited from the advise of the justices (the Chief Justice was a member of the Commission) agreed on 22 principles for possible inclusion in a declaration on environment and sustainable development. You will find them in the first appendix in the report.

The transition to sustainable development will require decisions that are politically difficult and the Commission felt that an immense effort will be required to inform the public and secure its support. The scientific community, industry, private and community groups and NGOs have a critical role to play in this. The right to know and have access to information is fundamental to that role; so is the right to be consulted and participate in various appropriate ways.

The Task Force took up this theme. It called for a number of things including government-industry round tables reporting directly to the first ministers.

The right to have access to information is limited by the value of the information. We are flooded with data, but we have little in the way of information. Information power is a reality and the Commission urged every country to strengthen its presently weak capacity to provide authoritative information relevant to policies for environment and sustainable development, for example, new systems of environment and resource accounting to complement our national accounts, so we can tell the extent to which we are gaining or losing basic capital, independent assessments of policy, policy audits – a proposal echoed at the Costs of Inaction Conference.

In conclusion, I would like to underline again that the forces which are shaping the future of our planet today are more than ever the product of human activity and subject to human control. We are literally in command of our own future on this planet and whether we succeed or fail, the decisions and the responsibility will have been ours.

Notes

1. World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987).

2. National Task Force on Environment and Economy, *Report* (Ottawa: Canadian Council of Resource and Environment Ministers, 1987).

Chapter XI

Can There be Models for Sustainable Development?

Kenneth E. Boulding

Development is a difficult and complex concept and sustainable development even more so. We should start perhaps with the general concept of evolution, even though this has broader or narrower connotations. The broadest concept is simply that of the space-time pattern of the universe and its parts, visualized as a kind of three-dimensional movie, with frames representing the state of the universe, or any particular part of it, at a certain moment of time. The succession of frames for successive moments of time makes the movie. There are several plots in these movies. Perhaps the simplest one is that of the universe expanding from the "big bang," although this is much more complex than blowing up a balloon. We are becoming increasingly aware of the complexity of the structure of galaxies and so on, which suggests that the expanding universe is not simply everything moving away from everything else.

When we come to the earth, the record of the past, fragmentary and distorted as it is, suggests ongoing processes that have a pattern through time. First, there is the physical pattern: the plate tectonics of the shifting continents, the upthrust and erosion of mountains, the filling up of lakes and deltas, and so on. Plate tectonics certainly does not exhibit any signs of equilibrium unless we adopt the theory that the earth wants to be a tetrahedron, which accounts for the movements of the continents. There is not much evidence for this.

After the puzzling and improbable introduction of DNA, we get the evolution of life. Even the record of life is so fragmentary that there is great opportunity for disputes, like the current dispute about the extinction of the dinosaurs. Certainly, a general pattern is perceivable, with what looks like two or three "time's arrows." There is a movement towards complexity and cybernetic structures – warm-bloodedness, the senses, and all that – and a movement towards intelligence and consciousness.

This brings us to the concept of development, which is related to some concept of evolution with a time's arrow, in which something related to the total system gets more or less. We can see this even in the expanding universe. It gets bigger in some sense, occupying more space, but whether it gets bigger in terms of mass, energy, or mass and energy together, we do not really know. Was the existing mass and energy created in the big bang or have there been little bangs? We simply do not know this. When it comes to biological evolution, we have an intuitive feeling that this represents some sort of progress, at least in terms of the complexity of organisms. It is not unreasonable to suppose that the human race has something which is more than what the chimpanzee, the dog, or the amoeba has, even if this is only defined in terms of power to change the system and the future.

When we look at human history, several developmental processes in terms of "more" can be detected. One is simply the increase in the human population itself. There are a lot more human beings on the earth than there were in the past, and on the whole the record has been one of steady growth in numbers, accelerating dramatically, of course, in the last few centuries, especially in the 20th century. We could certainly identify growth in the total stock of human knowledge, what Teilhard de Chardin calls the noosphere. We know more about the world and the universe than did our ancestors, and this, again, has been steady growth with a few ups and downs. I know there are volcanos on Io, which my father did not.

Economic development is usually assigned to a given area, sometimes, of course, to the whole world. It is generally thought of in terms of an increase in riches, especially per capita. Riches is a rather ambiguous concept, as it has both a capital stock and an income flow aspect to it. On one side, to be rich is to have a nice big house full of elegant furniture, a big garden, three cars, a good library, closets full of clothes and shoes, perhaps even servants, and so on. This is the capital stock aspect. The income aspect arises partly because all things depreciate with use and with time, with some possible exceptions like the maturing of wines – perhaps even the maturing of children and young people. To maintain, and still more to increase, our capital stock, we must have a constant inflow of income, whether this comes from a job, or from being self-employed and making things,

or from interest, profit, or grants. The bigger the income, of course, the bigger the capital stock we can maintain, and also the easier it is to increase our capital stock. The income and capital aspects of riches are very closely related.

Economists measure riches by an income quantity for a total population. This is often calculated in terms of a gross product, or for some purposes, a net product. The gross national product (GNP) indeed has become one of the great symbols of our age, for people rarely ask how it is made, what it consists of, and how it is distributed. Nevertheless, it does little harm to take it as a measure of riches if we then go on to explore a further dimension of development, for which, unfortunately, there is no very good name. We could call it welfare, quality of life, or just plain goodness or betterment. In this larger context, the concept of development cannot be separated from human valuations. All human valuations, of course, are acts or judgments of individual persons. Nevertheless, underlying these individual valuations there is sometimes quite surprising consensus as to whether things are moving for the better or for the worse.

We can postulate a "goodness function," $G = f(a, b, c, \ldots)$, where goodness (G) is a function of a, b, c, . . . etc., representing the state of the relevant universe, or whatever we are evaluating. There will be a considerable degree of agreement as to what should go into this function. We agree with remarkable unanimity that good health is better than bad health, that up to a point being richer is better than being poorer, that being secure is better than being insecure, that being part of a loving and supportive community is better than being an isolated individual, that being wise is better than being foolish, that the beautiful is better than the ugly, that peace is better than war, that friendship is better than enmity, that knowledge is better than ignorance, that sanity is better than insanity . . . and so we might go on. There will be differences as to what weights we give to these various elements in the function. There is a problem also of tradeoffs, that an increase in one element may lead to a diminution or an increase in another, and these tradeoffs may be variously estimated by different people. Thus, increasing justice may diminish freedom, increasing riches may increase aggressiveness, and so on.

A goodness function is also non-linear. It tends to exhibit what I have sometimes called the "parabola principle." If we plot goodness vertically and some element in the goodness function horizontally, the curve will have something like a parabolic form. That is, if we take any particular element, shall we say riches, there will be wide agreement that when we are poor, an increase in riches is good. As riches increase, however, we may get to a point where riches is no longer good, and beyond which an increase is bad – corrupting, boring, and cluttering up life.

Even though it is hard to put exact numbers to the goodness function, we use it constantly. We could contemplate two countries, for instance, with exactly the same per capita GNP or some other measure of riches. In one, however, this is devoted heavily to armaments and the war industry; riches are concentrated in a small part of the population who live extravagantly, whereas the mass of the people are poor and a proportion destitute. The other country may devote its resources to education and to the arts, may have a fairly equal distribution of income so that there are few poor people, the average person enjoys better health and a longer expectation of life then in the first country, and so on. We would hardly hesitate to say that the second country was better than the first, though they are equally rich by some measure.

We also run into what might be called "single-value goodness functions," where one element in the function so outweighs all the others that they become virtually invisible. Thus, an ardent devotee of some ideology might think the world would be better if more people accepted this ideology, even though it might become poorer, more violent, less cultured, and so on. Single-value goodness functions have been responsible both in the past and in the present for "development," that is, a worsening of the general condition as judged by multi-valued goodness functions. One thinks of Hitler, Stalin, Khoumeini, and Torquemada of the Spanish Inquisition, as striking examples. It would not be difficult to think of others.

Sustainable development is also a concept with many meanings. We can even go back to the expanding universe and ask: can it expand forever? Some cosmologists think it can; others think it will reach a limit and then contract in on itself, perhaps into another "big bang." The fertilized egg has a potential for development, for growth in size and complexity from embryo to adult. On the other hand, we know that the development of a single biological organism is not sustainable. Thus, in the plan of the genes there is not only growth and maturity, but old age and death. Ecosystems are much more sustainable than organisms because living organisms are capable of reproducing themselves, and if the environment of the ecosystem does not change, the populations do not suffer genetic mutations. There seems to be no reason, therefore, why an ecosystem should not go on indefinitely with equilibrium populations, in which each individual is born, grows, and dies, but in which the total populations are stable in regard to their composition. Ecosystems, too, however, change, first through irreversible change in their physical environment, through climatic change, soil erosion, and so on. There is also ecological succession: lakes turn into bogs, bogs turn into forests. Climactic ecosystems, which may exist for a long time, gain their sustainability at the cost of development. Equilibrium may be sustainable for long

periods—a good example of this would be the solar system itself—but it is sustainable precisely because it does not have development, that is, it does not change either for the better or for the worse.

In an absolute sense, of course, ecological equilibrium is unknown in the real world, even in a climactic ecosystem. Genetic changes are continually going on through mutation. It is possible to imagine a mutational equilibrium in which all possible mutations are adverse and produce phenotypes that will not survive. There is some evidence, indeed, that towards the end of a geological era something approaching a mutational equilibrium develops, with very slow change in life forms. It is frequently some catastrophe that upsets this equilibrium and starts evolution off again, by providing new niches for mutations that would have had no chance of surviving in the old equilibrium. Thus, it seems probable that the extinction of the dinosaurs led to mutations in the small mammals which permitted larger and larger mammalian organisms to fill the empty niches left by the extinct dinosaurs. If this had not happened, we might not be here today, for the development of the human race depended on the existence of an ecological niche for something with our size (a mouse is not big enough to have a human-type brain) and with our extraordinary capacity for learning and consciousness.

The pattern of human history and human society exhibits many of the characteristics of the pattern of biological evolution, with some important differences. The human race exceeds any other living organism by orders of magnitude in its capacity for producing artifacts—clothing, furniture, houses, roads, automobiles, airplanes, and so on. Each artifact has a population: things are born into it (that is, are produced) and eventually die (are scrapped). Artifacts do not have much of a childhood, although there is a breaking-in period for an automobile, machines are often improved by adding accessory parts, and some things increase in value by becoming antiques. The principal difference between societal and biological evolution is that the genetic information which produces artifacts is not contained in the artifact itself, but exists either in human brains or in other artifacts, like blueprints, computer programs, and so on. It is perhaps this property which has led to the enormous multiplication of artifacts, to the point now where the total mass of artifacts in the cities far exceeds the mass of biological organisms. With artifacts, mutation can go on very rapidly in the form of new ideas, inventions, discoveries, and so on, and this rate of mutation has accelerated spectacularly with the rise of civilization, and still more with the rise of science.

Artifacts require energy to produce and sustain them, and materials out of which they are built and manufactured. These are limiting factors, as they are also in the biosphere itself. The genetic

factor of know-how is essentially an elaboration of the information structure which creates the potential for producing species, whether of cockroaches or of automobiles. Limiting factors may prevent this potential being realized: the low energy input in the tundra prevents the growth of trees, the absence of water in the Sahara prevents the growth of whales as well as of forests, and sometimes the absence even of trace elements prevents the growth of certain plants. Similarly, it is hard to develop writing in hunting/gathering societies with nothing much to write on, and perhaps no need for expanding communication beyond the oral range. Once writing develops, however, it is possible to instruct people who are a long way off. It is also possible to teach people using communications from the past as well as the present. It is not surprising that writing expands the scale of organization and develops empires and civilizations.

Historians and philosophers tend to see human history in stages – hunting-gathering, pastoral, agricultural, urban civilization, post-civilization, and so on. These may represent quasi-climatic human ecosystems where change is slow within each stage, even though each stage may include a variety of societies. It is a common view that the succession of these stages represents development. Succeeding stages certainly represent growth in something or other. There is no doubt, for instance, that the human population grows from each of these stages to the next. Along with the growth of population we may see a growth of riches, from the scanty possessions of hunter-gatherers to houses, furniture, pottery, and metal work under early agriculture; the cities, armies, and palaces under civilization; and the automobiles, airplanes, and, one should add, nuclear weapons, under post-civilization. There has been a tendency for the human capacity to produce artifacts to rise, mainly as a result of the learning process, but also as a result of the opening up of new niches as one mutation offers opportunity for the survival of others. Thus, if we ask why there were no automobiles in 1800, the simplest answer is that we did not know how to make them. There would have been no niche for automobiles and the internal combustion engine, if there had been no gasoline. There would have been no gasoline if whale oil had not become scarce and an oil industry had not developed to produce kerosene for illumination, where gasoline was a by-product. This sort of process has been repeated over and over again, as one invention opens up new niches for others.

The question of the sustainability of these processes of human development is extraordinarily difficult because of the fact that they are disequilibrium systems. Hence, it is hard to predict how long development can go on. A number of factors have the potential for limiting human development, slowing down rates of change, and even leading to something like equilibrium. One of these is the human

population itself, as Malthus pointed out with such brilliance. Darwin, indeed, confessed that he got his idea of natural selection from Malthus. Any species in a stable ecosystem, whether of field mice or of automobiles, will have an equilibrium population. For populations below that level, births will exceed deaths: for biological species because it becomes easier to find food and harder to be found as food for something else, for artifacts because there is unsatisfied demand, leading to higher prices, which will encourage production. The population will grow. If the population is above the equilibrium level, the reverse takes place and population will decline. This is all implicit, incidentally, in Adam Smith's theory of natural price.

The evolution of human society also differs from biological evolution in that it involves power, which emerges out of consciousness, images of the future, decisions, and the ability to change the future. The dinosaurs never knew that they were not sustainable and if they had known, probably could not have done anything about it. Human beings are aware of the world around them and have the capacity for forming images of the future. We see this perhaps in a primitive form in animal behavior. Biological species have a certain instinctive know-how as phenotypes, which they derive from their genotype. But many of them also have a capacity for learning, which results in what I have called "noogenetic" evolution, that is, learned structures which are transmitted by a learning process from one generation to the next. In humans, noogenetic evolution becomes of overwhelming importance, not only for human beings themselves but for the whole ecosystem of the planet. There is no question that we are in an evolutionary catastrophe – of which there have been many in the past – and that because of the human race the rate of extinction of species may now be larger than it has ever been in the history of the planet. These extinctions largely result from artifacts competing with many biological species, especially when these artifacts are biological species themselves, as in agriculture and livestock production. Indeed, with the "green gene revolution" we may be on the verge of much larger changes here, creating new biological organisms on a large scale, which will be competitive with the older ones and may drive many of them to extinction.

Another important factor in the sustainability of ecosystems is the physical environment in which biological, and especially human, organisms have the capacity to change. The first example of this may have been the creation of oxygen in the atmosphere by the early forms of life, which eventually killed most of them off but permitted the development of more complex oxygen-using organisms. The human race is now in the process of profoundly changing the atmosphere by burning up fossil fuels and so increasing CO_2 and other gases and

depleting the ozone layer. We are also changing the soil world-wide; it is rapidly deteriorating and eroding, though how rapidly is a matter of some dispute. We are even changing the oceans, where we are affecting their ecological equilibrium by over-fishing and pollution.

An important aspect of the problem of sustainability is the exhaustion of resources, such as fossil fuels and various material substances, such as metals. There is a process of materials entropy at work here. As a result of plate tectonics and geological processes, human beings found the earth with heavy concentrations of ores and minerals. As a result of the production of human artifacts, we are now diffusing this concentration, partly to the oceans, partly in dumps all over the world, partly into the atmosphere. Economists point out that resources end with a whimper rather than with a bang; as we use them up they become scarcer and their relative price becomes higher, leading both to reduced use and the utilization of poorer, more expensive sources. This principle may make the "all gone" theorem less dramatic, but it cannot ultimately deny it.

The sun produces an inexhaustible flow of energy which is large although very diffused and hard to capture. Some of it is captured by the biosphere but inefficiently. I understand only 1 or 2 per cent of solar energy is actually utilized by living organisms. The development of photoelectric cells is encouraging and represents a large potential reserve when the price of increasingly scarce fossil fuels rises sufficiently. Over the long run the materials problem may be much more severe than the energy problem. Earth is a closed system in respect to materials and the concentrated deposits are being diffused constantly. It will take a great deal of energy to re-concentrate them. Mining the asteroids seems improbable, but it is at least not absurd; the energy requirements for travel in space are extremely low, as there is no friction and very little gravity to overcome.

The principal source of our ignorance about the future is that we cannot know what is the potential of the "ultimate resource," as Julian Simon calls it, the human mind. If we could predict what we are going to know in the future, we would know it now. A further problem is that the growth of human knowledge does not seem to be exponential, although it rarely declines. A period of growth of knowledge is often followed by long plateaus in which the knowledge stock, or noosphere, does not change much. At the moment we are in the midst of an enormous upsurge, covering the last 500 years, as a result of the development of the scientific subculture. How long this can go on, however, we really do not know. There are certainly some signs of a slowdown in ordinary daily life and economic productivity. I have often said that my grandfather saw much more change than I have seen in my lifetime in terms of the technology of daily life. I

grew up in the modern world, my grandfather did not. I do not remember a time when there were no automobiles, no electric lights, no telephones, though I do remember the coming of television and even the first radios when I was a boy. I have, of course, seen the coming of the computer, but this has had much less impact on ordinary life than did the automobile and the telephone. We cannot brush away the possibility that we may be gradually sliding into a more stationary state, both beloved and feared by economists, in which technology will not change very much. Neither will the total stock of capital or the total population change, and one year will be very much like the next, especially economic life. John Stuart Mill actually thought that this would be a delightful state of affairs, in which you would not have to worry about getting any richer, but in which you could enjoy what riches you have in culture and in the benign pleasures of life. He may have been too optimistic.

The stationary state may not present real problems for a centrally planned economy, although the Soviet Union seems to be exhibiting a slowdown. But for a market economy, a stationary state could easily lead to high levels of unemployment and even economic collapse unless effective means could be found for preventing aggregate attempts to save through restricting consumption or household purchases. This is particularly important for the receivers of profit. If there is no net accumulation of capital, then unless they devote all their income to household purchases in aggregate, inventories of consumer goods will accumulate, profits will decline, and unemployment will rise. This is a problem we have never really had to face. We came close to it in the Great Depression, when in 1932 and 1933 in the United States, and most of the capitalist world, profits were negative, the interest burden was almost doubled, unemployment was 25 per cent of the labour force, net investment was negative, and the whole economy seemed on the point of collapse. The rational-expectations people suppose – or perhaps we should say, fear – that policies of the government and the central bank cannot even offset this because of the change in expectations that will be produced. This seems a bit too pessimistic. I know of no nonexistence theorem about the successful management of the stationary state, but we have to admit there are important problems here that have not been solved.

The standard economic models of development are seriously flawed. One thinks particularly of the so-called Harrod-Domar Model, which assumes a constant capital-income ratio and neglects the factor of know-how or technology. It also neglects the possibility of capital-saving improvements which can be important. The problem with virtually all attempts at macro models of the economy – and the same goes for the Forrester and the Club of Rome models – is that they tend

to assume certain ratios to be constant which in fact are never constant. The capital-income ratio is only one case in point. The assumption of a constant propensity to consume, for instance, frustrates a lot of econometrics, and the bigger the model, the more implausible constants are likely to be found in it. Furthermore, there is a failure to recognize that the composition of an aggregate may be much more important than the number which usually imperfectly represents its size. The so-called "Cambridge capital controversy" of the 1960s reflects this problem. Capital is a heterogeneous collection of populations of large numbers of different kinds of artifacts. Its overall valuation in dollars is important for financial structures, but its physical composition is what is important for development, and this is usually overlooked in macroeconomic models. What might be called "Newtonian model building" in economics has about the same kind of success that celestial mechanics would have had if the planets had really been moved by angels who did not like astronomers, and if the gravitational constant varied from day to day and depended on the position of the planets. This is a beautiful example of the principle that in the growth of human knowledge nothing fails like success, particularly success that other people try to copy. The success of celestial mechanics depended on the fact that the evolution of the solar system had ceased; the attempt to apply these kinds of Newtonian models to evolutionary systems has been disastrous.

Nevertheless, the search for at least moderately stable relationships between the past, the present, and the future must go on if we are to have any viable images of the future at all. The evolutionary model is inherently unpredictable, but has limits, and it is important to find where these limits are, to know what is impossible, and to perceive at least tentative stabilities in the possible relationships. In these matters, however, it may be more important to know what is impossible than what is certain if we are are dealing with highly probabilistic systems. We have to think of development as a multi-dimensional process with an upper and a lower boundary. Then the question is how to get closer to the upper boundary rather than the lower one. The lower one may be pretty far down. It is not impossible that the human race might destroy itself and its evolutionary process on the earth grind to a stop.

It is useful to ask therefore: what are the conditions, institutions, and even accidents, that move society, or the whole world, towards the upper boundary? What prevents movement towards the upper boundary or turns us downward? A fruitful approach is to consider the nature, the limits, and the distribution of human power. As noted earlier, what distinguishes societal evolution from biological is that with the development of the human race, power, in the sense of decisions which affect the future, becomes of great importance.

Animals exercise some power, but only over small systems. The human race exercises power over the whole ecosystem of the planet or even of the whole solar system. The power of a decision maker, whether a housekeeper or a dictator of a superpower, depends on whether the images of the future in his or her mind are realistic, and also on the nature of the valuation process by which these images are appraised. Ignorance and unsustainable valuations usually lead to the destruction of power, but also often lead to a worsening of the human condition.

Power is a complex phenomenon, not easy to categorize. The interaction of different forms of power is important in estimating its total effect. One useful taxonomy of three interacting forms of power is: (1) destructive power, associated with threat, (2) productive power, associated with exchange and with economic life, and (3) integrative power, which is the power to attract respect, legitimacy, love, to build community and consensus. It is a common illusion that destructive (threat) power is the ultimate, most important form of power. I would argue that it is the least important form of power, that productive (economic) power can be much greater, and that integrative power is the foundation of the other two forms. Unless there is legitimacy, threat is ineffective. Few people get rich by naked threat. The armed forces contribute to the power of government only if they are accepted as legitimate, as revolutions have demonstrated. Integrative power is subtle, hard to quantify and pin down, but it does represent a kind of field in the social system, almost like a magnetic field, which draws some people together and drives others apart. Organizations, and especially large organizations, cannot come into existence unless there is some legitimate hierarchy. Authority is granted from below. If it is not granted, it disintegrates.

Looking now at the relationship between the general structure and patterns of a society and the likelihood of its undergoing a developmental process in terms of the "goodness function," in the light of the evolutionary model, we have to ask ourselves: what are the institutions and the images of the world in the minds of the people of a society which hinder the spread of what might be called "benign mutations," whether in the production of artifacts or in the production of ideas and organizations? Some societies, especially small and simple ones, try to suppress mutations and achieve ideological, economic, and political equilibrium. This can be effective in preventing further evolution, as the extraordinary stability of paleolithic cultures testified. In larger and more complex societies it becomes harder to prevent change, although there are some quite complex societies that have been backwaters for long periods. Other societies have been friendly to change, skilled in differentiating between good change and bad change, encouraging the first and

discouraging the second, and so on. We need perhaps to look for limiting factors. In political life, an excessive reliance on threat and conformity, applied both internally and externally, suppresses benign innovations. Empire, for instance, has almost always led to the economic stagnation of the imperial power, which has to devote itself to knocking people down instead of building things up. Political freedom, which can sometimes be achieved rather sneakily, can be an important factor in development. One could almost argue that there is an optimum distribution of power from the point of view of development. Societies with highly concentrated power are apt to discourage development. On the other hand, anarchy can suppress it as well, as we see in Lebanon.

In economic life, also, something like an optimum distribution of power can be postulated. Just where it lies is hard to say and may depend on other elements in the culture. The market system exhibits an "invisible hand" just like an ecological system does; in fact, it is a special case of an ecological system, with populations of artifacts. Both economic and ecological systems, however, are subject to pathologies. If mutation produces a predator that is so efficient that it eats up all its food supply, it too will die out. In economic systems, such things as inflation and deflation, perverse positive-feedback processes and speculative markets that produce meaningless fluctuations, the development of addictions, that is, goods that increase the want that they purport to satisfy, the erosion of profit by interest, which easily leads to unemployment, the "Mathew Principle" – to him that hath shall be given – which leads to unacceptable inequalities, and so on, can all be identified as pathologies.

In social life there are perversions of upbringing and early childhood experiences which produce individuals who cannot adapt to the system around them. We have educational systems which produce avoiders rather than approachers, that is, people who know that they don't like, but don't know what they like. This leads to all sorts of malaise both in political life and in family life. Some organizations, such as the unilateral national defense organizations, require enemies to sustain their identity. These pathologies are not always easy to identify, but it is important to be aware of them.

It is clear that sustainable development is not automatic and that it is closely related to the general development of the human learning process. Perhaps one of the most important questions here is: how do we learn how to learn? Our ability to answer this question may determine the answer to the more critical question: can we learn in time?

The Brundtland Report

The Brundtland Report is a Cook's tour of the world situation in regard to sustainability. It covers the field well in terms of the problems. The quotations from the hearings that were held all around the world are extraordinarily moving and give a sense of reality to the report which is often hard to achieve in dealing with problems that are so large and so worldwide. What the report fails to do is to link the problems with the world power structure. Its tone is a little preachy—"we must do this, we must do that"—and preaching always runs into the danger of preaching to the converted. It does not really come to grips with the question of whether the behaviour of people in positions of power can be changed by new ideas and new images of the world, which is by no means impossible. Where this cannot be done, however, the question arises whether the persons in powerful roles can be replaced by other persons who have a better capacity for learning and a stronger sense of the realities of the world.

What is missing from the discussion of these large world problems is a discussion of what are the sources of power and what kind of events are most likely to lead to changes in the way in which power is exercised. This is a delicate subject. People in power do not want to be challenged in the exercise of that power, although this does happen. Even powerful people occasionally change their minds, although this is not easy for them. The processes by which people occupy powerful roles are complex and various and have a strong random element in them. One thing that is clear is that violence produces pathological leaders, like Cromwell, Napoleon, Stalin, and Mao. Military defeat usually produces much better leaders and people in positions of power than does military victory. Argentina after the Falklands-Malvinas War is a good case in point, so is Paris after 1871, or Berlin after 1919. These are neglected problems when it comes to looking at how things change for the better. They deserve to be studied more than anybody is studying them now, especially by historians.

Chapter XII

The Brundtland Commission: Pathways to Sustainable Development[1]

Ian A. Stewart

In a time such as ours, when inherited myth systems are in disrepair and no great political leader has as yet emerged, historians, political scientists and other academics who are paid to educate the young and think about matters of public importance ought to feel a special responsibility for proposing alternatives to accepted ideas. Only so can they hope to trigger a successful reorganization of public myths that could command the support of informed and critical minds. To leave the field to ignorant and agitated extremists is dangerous.

Myth lies at the basis of human society. That is because myths are general statements about the world and its parts, and in particular about nations and other human in-groups, that are believed to be true and then acted on whenever circumstances suggest or require common response. This is mankind's substitute for instinct. It is the unique and characteristic way of acting together. A people without a full quiver of relevant agreed upon statements, accepted in advance through education or less formalized acculturation, soon finds itself in deep trouble, for, in the absence of believable myths, coherent public action becomes very difficult to improvise and sustain. William H. McNeill,

"The Care and Repair of Public Myth," *Foreign Affairs*, 1982, Vol. 61, No. 1.

It is a daunting task to explore in twenty minutes or so the implications of the Brundtland report. The report itself is daunting. And it centrally urges a revolution and integration of thought and action across a range of territory and disciplines that could not conceivably be canvassed by the most "renaissance" of modern minds.

What makes the task more daunting still is that so much of its prescription appears to run directly counter to what might be called the current structure of public myth. While a conservative liberalism seems to have mounted the stage world-wide with its language of individualism, privatization, deregulation, the efficacy of markets, the destructiveness of the welfare state and the virtues of less government, the report speaks a language of law, regulation, public policy, more international collaboration and cooperation generally, and the virtue, nay the dramatic necessity, of equity. While the report notes a declining degree of international purpose and collaboration and recognizes the radical character of its prescriptions, it seems almost disingenuous in its failures to confront the ideological gulf between where we are and where it would have us be, and to offer some thoughts on how that gap might be bridged.

While Chicago economics leads a profession that comes close to denying the existence of public goods, and Virginia asserts that political and bureaucratic activity are merely means to private ends and hence incapable of administering public goods even if they exist, the report is all about public goods, the "commons," and the imperative of governments acting in the collective interest. And while Harvard long ago abandoned its examination of the social responsibility of the corporation in the face of an onslaught of conservative reaction, and even business journals lament the short-sightedness of current corporate practice, the Report speaks optimistically of evidence of a growing corporate awareness.

How to come to grips with this? We are not here critically to analyze the report but to try to be wise about where its implications ought to carry us. And I, for one, do not propose to doubt the environmental analysis from which the report's prescriptions flow. I am schizophrenic enough to believe that we indeed have a very limited number of years in which to avert ecological calamity and a greying of the 21st century, while entertaining a faith that the worst may be averted. I do have a hunch, however, and perhaps this is my first point, that despite the extraordinary drama of the report's conclusions, they have as yet to acquire a mythic quality for many more than the environmental cognoscenti. Though public opinion polls continuously reveal a welcome degree of environmental

sensitivity, they at the same time reveal an astonishing insensitivity to patterns of national and international inequity and the essential synthesis of these elements so central to the logic of the report. Presenting the analytical portions of the report with something of a more attention-getting primal scream while seeking less than full consensus in the prescriptive portions might have been a more effective strategy. How to bring the analysis to the attention and understanding of broader publics and how to institutionalize its updating might be a first question that this workshop would wish to consider.

I confess I am restless as well with the central concept of sustainable development. I can recognize the Commission's concern to shape a vision that could command world-wide support. I have sat in enough policy chambers to recognize as well the needs to find some structure that can enable agreement. But it has for me a-cake-and-eat-it-too quality that runs a grave risk of overstating the possibilities and nurturing frustration and disillusion. Given the Commission's target growth rates, and despite the central role that equity plays in the argument, the gaps between rich and poor will remain of destabilizing proportion. More may be demanded of us than the report allows. More importantly, perhaps, I am not as convinced that economic development, in its traditional forms and in the developed world, need be as critical to the world's or our own welfare as the commissioners view it. They bring to the notion of the stationary state a sense of homogenizing ennui of which those who speak of equity are often accused. I cling a little to Mr. Keynes' vision of a world in which "the economic problem has ceased to be the permanent problem of the human race, and in which development has come to mean that 'we honour those who can teach us how to pluck the hour and day virtuously and well.'" Perhaps more importantly, still, the logic and the rhetoric of the report, and perhaps the effectiveness of the revolutions the commissioners would urge, may draw greater inspiration from a vision of the economy operating within the biosphere rather than alongside it.

This is not a trivial point. The deep intellectual puzzles which inhabit the world of the provision of collective goods and the amelioration of lesser forms of negative externalities have only begun to be understood and their implications explored. My bible in these matters is Fred Hirsch's "The Social Limits to Growth," a book which I fervently wish had received greater attention. But one can find much of the analysis and understanding in the works of our esteemed guest, Kenneth Boulding. The central point is that it is not enough for an individual to want to act in the public good unless there is some organizing principle which can provide assurance that all will so behave. The Commission conjures up a world in which "rather than

the pursuit of self-interest contributing to the social good, pursuit of the social good contributes to the satisfaction of self-interest." I need no persuading. But the pursuit of the public good, as Hirsch notes, has to be deliberately organized under "existing standards and instincts of personal behaviour." The Commission calls for collaboration, cooperation, more attention to equity, and a massive role for governments and international institutions in a world that is to some degree in flight from these values. And it can be demonstrated as irrational for me, i.e., against my self-interest no matter how enlightened and how sharing of the Commission's means and ends, to act in their furtherance unless I can somehow have assurance that all will so behave. The Commission's inattention to this problem, the problem which Michael Ignatieff describes as the one before which all political thinking has stopped, is striking.

So back to the organizing principle. What is it to be? A good deal of the Commission's choice is law and regulation and the elaboration of international rules of behaviour administered by existing and new international institutions. But if this is not to be a management structure whose workings are obeyed to the letter but not in the spirit – if genuine collaboration and cooperation is to obtain – then it seems critical that broad assent be obtained from those who are ruled. Indeed, such assent may be the sine qua non of confronting the challenge which the Commission poses. Further, to the degree it can be cultivated and internalized as a change in social ethic and perception, the weight of law and government need be less, the intrusions on personal and corporation freedoms seen as less oppressive, and the possibilities rather than the constraints conjured with. This is not behavioural change that is necessarily required but an adaptation of the internalized sanctions that we all carry with us and that shape our behaviour whether we like it or not. This is not altruism but learned behaviour "as if altruistic," to borrow Hirsch's phrase again.

The first and indispensable step must then be a massive program to diffuse and have the Commission's analysis (but not necessarily prescription) understood. Institutions of management must flow and gain sanction from these understandings rather than the other way around. The first step, it seems to me, must be a large investment in the gathering and disseminating of information well beyond the already committed who would too quickly guide and lead the movement, and passed through the sieve of analytical interpretation – the shaping of a new set of myths – for our times. If processes of institutional change and the restructuring of government institutions are to be effective, they must be sanctioned by public understanding. I do not intend no role for leadership but to caution that leadership that attempts to carry Brundtland too far in the van of

public understanding or to be excessively elitist in its composition will not be able to contend, in my view, with the present structures of individual and collective resistance.

When one confronts the international situation, the landscape becomes even more intimidating. The Bretton Woods institutions were born out of the searing experience of the thirties and the Second World War. But they were also born out of a remarkable consensus, shaped nationally by commitments to national programs of employment and growth, and internationally by a similar shared vision of a community of interest (even though that community was largely limited to the particular interests of the developed world). The internalized sanctions against the devastating consequences of trade wars led to the GATT and consensual erosions of national sovereignties in the interests of the international order.

Perhaps the GATT model may once again be the appropriate model to seek to manage the profound structural changes and environmentally benign trade flows of the 21st century—a forum in which free-riding in the form of pollution havens meets international disapprobation and strengthens national resolve but one in which licences to pollute, comparable to the safeguard provisions of the GATT, permit some flexibility in international administration and some tilting of the game to the benefit of the developing world.

I have been, in some respects, critical of the Brundtland Report, not for its refreshing reminder that collective goods may dominate our estate but for its neglect of the radical implications of this view. But, like the prospects of hanging, it has served to concentrate the mind wonderfully. It has also given rise to a stirring of intellectual attention that is long overdue. If I am nonetheless cautious about prescription, it is because I believe that some of the best intellectual work of the past decade ought to have instructed us that if "the invisible hand" is to aid and abet the revolution, it must operate on the basis of a radically reconstructed social rationale for private and public pursuits.

Note

1. These notes reflect the humane and civilizing influence of Gail Stewart. She has thought and written about, and sustained a deep commitment to, environmental issues, long predating the advent of the Brundtland Commission. Though she is, of course, not responsible for the details of my comments, indeed would probably differ in substance and emphasis, they have been shaped by her thought in more ways than I can any longer tell.

Chapter XIII

Impressions from the Workshop on the Brundtland Challenge

David Rapport

I have been given the unenviable task of attempting to summarize all that we have heard at this workshop over the past two days and to distill the main points. I say unenviable because it is impossible for one person to capture the many currents and thoughts that have been expressed here. The various contributions, interesting in their own right, are not always consistent or compatible with one another. In fact they are often contradictory. What I can do, and intend to do, is to give a more personal view which has naturally been inspired by being immersed in the discussions.

To begin with, some reference ought to be made to the connection between the current workshop and what is now called the sister workshop, the Cost of Inaction. Clearly, the current workshop has had a more specific focus on the environment, but there has been a great deal of overlap in that in both workshops the call has been made for fundamental shifts in the structure of our institutions, in the design of policy, and in social values. The focus of these workshops are the longer term strategies that might be followed to bring about a more healthy, equitable and just society, one which is better adapted to meet the present and ever growing challenge to provide a means of sustainable development.

It is evident that other groups, in particular the Task Force on Environment and Economy, are aimed in the same direction and in a

number of aspects the suggestions coming from this workshop mesh closely with the recommendations of the Task Force. In fact there were suggestions by some that we might, in the light of our discussions, review in detail the Task Force report and draw out those recommendations that seem particularly pertinent and of some priority.

The overall criteria for judging our current policies and programs might be reduced to four E's—environmental, economic, efficient, and effective. I detect a distinct undertone of frustration with our current institutions and policies when measured by these criteria. Some have stated that the Brundtland recommendations haven't a chance as they "go against the grain" of our present institutions. There have been suggestions that our institutions are far from proactive. At best they are, with long lags, reactive, and at worst obstructionist. This view, if even partially true, underscores the urgency for a re-examination of the manner in which environmental concerns are currently dealt with, and an urgent effort to effect major changes. There seems little doubt that the conservative bent now ensconced in many federal departments inhibits new initiatives in the environmental field, and much of the action can be expected at this point to come from provincial and local levels rather than from the national level.

We have by no means arrived, as a result of our discussions here, at the answers to our many common dilemmas, and we have scarcely articulated the questions. What we do recognize with each work-shop or roundtable on the subject of economy-environment is the enormous complexity of the task, the interrelatedness of the economic, social, political, and military infrastructure. It is only with a sense of great humility that one should make an effort to propose a course by which to steer. We all have a sense of the great limitations in our capacity to come to grips with these many and varied facets of the global problematic whether addressed at global, national or local levels. Inevitably, there will be partial solutions aimed at particular goals but which may at the same time produce unwanted and unforeseen impacts in other important domains in the fabric of sustainable development.

What we need is a wisdom that goes beyond the capabilities of our senses and our current capacity to think through problems of this scope, and if I may use a metaphor, this is of a complexity that requires recourse to the "third eye," that is a vision that goes beyond our current sensory perceptions.

I shall organize my impressions from this workshop around three I's, if I may now be permitted to shift the metaphor, which may serve to pull the varied aspects of the discussion into a coherent whole.

The first I is for Insight. To start with, we need more insight into exactly what the term sustainable development means in a global sense and what it means to Canada. To obtain this kind of an insight, we should look at specific sectors, for example, forestry, agriculture, energy, to develop the concept in concrete terms. One question is how planning sustainable development can take into consideration the cumulative, synergistics, and antagonistic effects of so many different facets of our social, biological, economic and political existence?

A second insight is needed into the value of the predominant economic paradigm. Kenneth Boulding has suggested that economics is no longer the dismal science but it has rather become the cheerful science. Cheerful, I suppose, because economics appears to offer solutions which avert, at least for the privileged few in the industrial world, the destitute situations faced by the other 80 per cent of humankind.

Cheerful as it may be, it is becoming more obvious that classical economic teachings are a mythical and highly irrelevant science, if they are still graced with that label. The real question is how to make economic analysis relevant to the real world and, for our purposes, environmental problems. The most prevalent and traditional approach of reducing all considerations to a balancing of costs and benefits notoriously fails to achieve this. Much in the way of environmental values are not meaningfully placed in the numeraire of monetary values. Even where on the surface there appears to be grounds for comparison, the long term nature of many investments which might enhance the sustainability of environment, when discounted by practically any positive rate of interests, renders the venture unprofitable. There is something obviously fundamentally askew when investments in our common future "don't pay." The problem lies not with the intrinsic value of environmental resources but in the approach and methodology which is currently ingrained in economic thought. What the economists so skillfully produce by a seeming slight of hand, making use of sophisticated mathematical models which are unintelligible to those outside their fraternity but purporting to encompass everything under the sun, amounts in my view to something close to sheer chicanery. It is almost axiomatic that the more sophisticated the mathematical apparatus, the more empty the content.

Then there is the insight in the challenge of Kenneth Boulding to "prepare for surprise but not be caught dumbfounded." We need research on the ways in which surprises arise, how extremely improbable events influence the course of environment, and how many influences, each of which appears benign, can and quite often does prove otherwise when acting in concert. What kinds of ground rules for future human endeavours need to be established to reduce

the risks of being dumbfounded? Can one effectively plan for the unknown or the improbable?

Finally, we need to take to heart a further point that Kenneth Boulding has underscored here, as did Gail Stewart in the earlier workshop, that the concept of separating environment from all other aspects of life is false and counterproductive. As Kenneth Boulding put it, "there is no environment, there is just a world." The implications of this, it seems to me, are far-reaching, for much of our thinking tends to treat environment as a separate tangible aspect from economic, political, and social life. To continue to do so is to undercut the prospect for achieving a sustainable development.

The second I represents Information. I would underscore here that the greatest need in information for the environment is credible information. We need to create an institution and a process to provide credible information. Obviously, what is called for is a body independent from those agencies that have the responsibility to regulate and monitor the environment, from those that formulate public policy, and from those that are responsible for the well-being of our economic institutions. This body would appraise and assess the extent to which the environment of Canada is changing, in a manner consistent with the achievement of sustainable development.

A persistent difficulty in the environmental information field is stale information. It is not even a question of real time but reasonable time. Too often we have information a decade or more out of date (e.g., resource inventories). This would not be tolerated in the economic field and it ought not be tolerated in the environmental field. Obviously, more resources are required to track the environment more closely and to develop overall assessments more rapidly. The dilemma is partly a lack of resources, and partly a lack of insight as to how best to deploy limited resources. For example, more effort might profitably be expended on development of environmental indicators at the ecosystem level. Concentrating the monitoring on a few, but critical, parameters which relate to the health state of ecosystems would be much more cost effective than present data collecting which often lacks conceptual focus.

Another aspect of the information question is the need to develop information in a form that gets to people. Given that our environmental future is a common future, the information must be accessible to individuals with vastly differing perceptions and education. Information that is scientific and technical, while it reaches the elite few that have the education to interpret it, is of almost no value in this form to a broad spectrum of society. Environmental information at present is by and large designed for the specialist, and is often in such a form that even specialists in various facets cannot effectively communicate among themselves. Left out is

the vast majority of the populace that lack technical backgrounds to decipher chemical formula, regression coefficients, and the like. There is thus an urgent need for translating the technical information to a common language that reaches the public. One approach may be to make use of the concept of "personal risk," that is, the significance to the individual of failures or deficiencies in various aspects of environment.

As to the form of the information, many have drawn attention to the need for accounts in physical, rather than monetary, terms which reflect the fundamental processes of depletion and renewal. The structure of these accounts ought to reflect not only the quantitative aspects of environment, e.g., the resource inventories, but the qualitative dimensions in which the quality of environment is given prominence as well. For example, it is not only the total biomass of the fish stocks in the Great Lakes that is of importance but also the composition of the fish community. To what extent, for example, have transformations in the ecosystem systematically shifted the biotic composition from the more ecologically and economically valued species to the less valued.

Turning to the third I, we highlight the need for a new environmental Infrastructure. The suggestion for appointing an environmental commissioner or ombudsman, who would represent environmental matters in the parliament, would provide, within the structure of our political system, an independent and stronger voice for environmental concerns and sustainable development.

Many have expressed the need for environmental accountability within the major federal departments. The call here is for systematic consideration of environmental concerns when policy is in the design phase. What is needed is to build into the structure of departments dealing with energy, agriculture, economic policy, and numerous other concerns, an environmental audit. Such an audit would make these organizations accountable for their actions in terms of safeguarding the ground rules that are being proposed for achieving sustainable development.

An encouraging sign, much in evidence in our country with respect to new infrastructure and one that has been encouraged by and inspired by the Brundtland Commission, is the creation of various roundtables and task forces to examine the means of integration of economy and environment. This process ought to be encouraged at levels from the local to the global. The approach that the International Joint Commission is now taking with respect to its areas of concern in the Great Lakes (the Remedial Action Programs) is exemplary in its effort to put into practice the call for a holistic integrated approach to environmental concerns.

I began these personal observations on a pessimistic note but I would like to end on a note of optimism. A number of actions which ought to provide better environmental insight, information and infrastructure are, I perceive, already underway. With respect to questions of insight, research on the nature of surprise and interlinkages of the economy and environment may not yet have evolved to a science, but it is already an active area and field of inquiry. Through this field of inquiry, our perception of the nature of the interactions, the nature of synergisms, the forces giving rise to instability and chaos, the nature of disequilibrium process, is growing, and to some extent we have shed the shackles of equilibrium-centred, mechanistic conceptions of our world.

With respect to information, Canada has started the process of producing periodic reports on the state of environment. These efforts have provided world leadership in terms of providing a framework for reporting on environment in terms of integrated ecosystems rather than the more traditional approach which separates the environmental components into air, water, and land. Moreover the Canadian SOE report (1986) suggests some of the interactions between economy and environment that are crucial to take into account for more balanced policy formulation.

With respect to infrastructure, it is encouraging to have two respected members of parliament here express their intent to put on the political agenda many of the concerns raised in our workshop. Finally, as I have already mentioned, we in Canada have taken seriously the recommendations of the Brundtland Commission and the Task Force on Environment and Economy by creating round tables, workshops and other forums in which to discuss the ways and means of achieving sustainable development and the necessary integration of economic and environmental concerns.

Appendices

Appendix A

Workshop Supporters

The following lists those organizations which financially supported the two workshops.

The Cost of Inaction

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The Brundtland Challenge

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Appendix B

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Harvey Lazar
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University of Waterloo

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Appendix C

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Arthur Cordell	- Science Council
Ann Whyte	- International Development Research Centre

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Claude Lefrançois	
Martha Johnson	Graduate students
Peter Fraser	

Appendix D

A Proposal

We need a vision of where we are going as a nation with respect to environmentally sensitive economic development. We believe that Canadians would like to be on the leading edge of global change with respect to "clean" industry and "clean" products twenty years hence.

For this purpose a Canadian economic development strategy that is environmentally sensitive will need to be developed and adopted. This strategy would need to be developed through a consensus process, broadly participatory, with all-party support.

We believe that this task might be done by the round table on environment and economy that are being created and endorsed by the provinces and the federal government, with the help and support from the scientific community of natural and social scientists through such organizations as the Royal Society and the Institute for Research on Public Policy.

We as members of this workshop request the sponsoring organizations to explore, *as soon as possible*, the Prime Minister's interest in having Canada take a leading role, internationally. This could be done by assigning to the round tables the task of developing, with public participation, a strategy for environmentally responsible economic development by Canada, for discussion by the Canadian people and endorsation by their governments.

We would, if the Prime Minister agrees with such an idea, then encourage the Prime Minister to share the idea with the Summit Nations and United Nations and encourage these nations to take similar action and subsequently to share the results in summit and other forums.

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The Royal Society of Canada publishes:

- Minutes of its *Proceedings* at the Annual Meeting;
- an annual volume of the Society's *Transactions*;
- *Proceedings* of symposia;
- *Diversa* (Newsletter) and
- *Calendar* of Fellows.

La Société royale du Canada publie :

- Les *Délibérations* du Congrès annuel de la Société;
- Les *Mémoires* présentées au Congrès annuel de la Société;
- Les *Comptes rendus* des colloques;
- *Diversa* (Notes et Nouvelles) et
- l'*Annuaire* des membres

A summary statement on *The Royal Society of Canada - 1882-1982* is available without charge from the Secretariat.

On peut se procurer gratuitement au Secrétariat un exposé sommaire sur *La Société royale du Canada - 1882-1982*.

Proceedings and Transactions

The *Proceedings* and the *Transactions* appear annually in two separate volumes. Fellows receive copies of the current issues without charge. For current issues the prices to non-Fellows are $6.75 for *Proceedings* and $13.50 for *Transactions*. Some earlier

volumes are available for purchase at prices depending on scarcity and condition. Inquiries and orders should be sent to the Royal Society of Canada.

Deliberations et mémoires

Les *Délibérations* et les *Mémoires* paraissent chaque année en deux volumes distincts qui sont distribués gratuitement aux membres. Le grand public peut acheter les dernières livraisons des *Délibérations* à 6,75 $ l'exemplaire et les *Mémoires* à 13,50 $. Il est encore possible de commander certains volumes antérieurs, le prix dépendant de l'état de la publication et du nombre d'exemplaires disponibles. Prière d'adresser toutes demandes de renseignements ou toutes commandes à la Société royale du Canada.

Index 1882-1982

The Index consists of author and subject entries for all papers published in the *Transactions* and other publications of the Society. Available for $30.

L'Index auteurs-matières renvoie ainsi à toutes les communications des *Mémoires* et d'autres publications de la Société. Prix : 30,00 $

Studia Varia

The scope of these volumes is indicated by the titles. Most volumes are now out of print. Asterisks (*) indicate those volumes that are available through the Royal Society; all others continue to be available through the on-demand publishing programme of University Microfilms, Ann Arbor, Michigan, U.S.A.

Le titre des volumes déjà parus indique la portée de ces études. La plupart de ces volumes sont épuisés. Les astérisques (*) indiquent les volumes disponibles au Secrétariat de la Société. On peut se procurer les autres volumes en s'adressant à University Microfilms, Ann Arbor, Michigan, U.S.A.

Studia Varia, E.G.D. Murray, ed., 1957

Our Debt to the Future, E.G.D. Murray, ed., 1958

The Canadian Northwest: Its potentialities, Frank H. Underhill, ed., 1959

Evolution: Its Science and Doctrine, T.W.M. Cameron, ed., 1960

Aux sources du présent, Léon Lortie et Adrien Plouffe, éds., 1960

Canadian Universities Today, George F.G. Stanley and Guy Sylvestre, eds., 1961

Canadian Population and Northern Colonization, V.W. Bladen, ed., 1962

Higher Education in a Changing Canada, J.E. Hodgetts, ed., 1966

Pioneers of Canadian Science, G.F.G. Stanley, ed., 1966

Structures sociales du Canada français, Guy Sylvestre, éd., 1966

* *Water Resources of Canada/Ressources hydrauliques*, C.E. Dolman, ed., 1967, $8.50

Scholarship in Canada 1967: Achievement and Outlook, R.H. Hubbard, ed., 1967

* *Visages de la civilisation au Canada Français*, L. Lamontagne, éd., 1970, $7.50

* *Le Canada français d'aujourd'hui*, L. Lamontagne, éd., 1970, $7.50

Special Publications/Publications spéciales

Collections of specialized scientific papers on a single theme or related themes have been published for the Society from time to time. Most volumes are now out-of-print. Asterisks (*) indicate those volumes available through the Secretariat of the Society; all others continue to be available through the on-demand publishing programme of University Microfilms, Ann Arbor, Michigan, U.S.A.

On a publié de temps en temps, pour le compte de la Société, des collections d'ouvrages portant sur un thème unique ou sur des questions connexes. La plupart de ces volumes sont épuisés. Les astérisques (*) indiquent les volumes disponibles au Secrétariat de la Société. Les autres ces volumes sont disponibles sur demande à University Microfilms, Ann Arbor, Michigan, U.S.A.

The Grenville Problem, James E. Thompson, ed., 1956

The Proterozoic in Canada, James E. Gill, ed., 1957

* *Soils in Canada*, Robert F. Legget, ed., 1961, water damaged copies, $5.50

Tectonics of the Canadian Shield, J.S. Stevenson, ed., 1962

* *Marine Distribution*, M.J. Dunbar, ed., 1963, $5.00

* *Studies in Analytical Geochemistry*, Denis M. Shaw, ed., 1963, $5.95

Crucial Maps in the Early Catography and Place-Nomenclature of the Atlantic Coast of Canada, with an Introductory Commentary and Map Notes by Theodore E. Layng, W.F. Ganong, ed., 1964

* *Geochronology in Canada*, F. Fitz Osborne, ed., 1964, $5.95

Continental Drift, G.D. Garland, ed., 1968

Appalachian Tectonics, T.H. Clark, ed., 1967

The Earth Sciences in Canada; A Centennial Appraisal and Forecast, E.R.W. Neale, ed., 1968

* *Glacial Till – An Interdisciplinary Study*, Robert F. Legget, ed., 1976, ISBN 0 920064 11 6, $15.00

* *Energy Flow – Its Biological Dimensions (The IBP in Canada 1964-1974)*, T.W.M. Cameron and L.W. Billingsley, eds., 1975, ISBN 0 920064 05 1, $5.00

* *Nuclear Issues in the Canadian Energy Context*, E.P. Hincks, ed., 1979, ISBN 0 920064 13 2, $8.00

* *Nuclear Winter and Associated Effects: A Canadian Appraisal of the Environmental Impact of Nuclear War/L'hiver nucléaire et ses effets connexes*, F.K. Hare, A. Forester, eds., 1985, ISBN 0 920064 21 3, $15.00

Proceedings of Symposia / Comptes rendus des colloques

These volumes comprise the papers presented at symposia held from time to time to deal with matters of scholarly and public importance. The contents in all cases are presented in English or French, depending on the language of the speaker. They are sold by the Secretariat of the Society unless indicated otherwise.

Ces volumes réunissent les communications présentées aux colloques tenus de temps en temps pour étudier des sujets importants dans les domaines d'intérêt public et du savoir. Elles paraissent, la plupart du temps, en anglais ou en français, selon la langue utilisée par le conférencier. On peut se les procurer au Secrétariat de la Société sauf les quelques cas indiqués.

1 *The Tundra Environment*, F. Kenneth Hare, ed., 1970, $2.00

2 *Mercury in Man's Environment*, J.E. Watkin, ed., 1971, $5.00

3 *Communication into the Home/Communications au foyer*, W.C. Brown, ed., 1972, $3.00

4 *Futures Canada/L'avenir du Canada*, J.T. Wilson, ed., 1973, $2.00

5 *Physics and Chemistry of Ice*, F. Whalley, S.J. Jones and L.W. Gold, eds., 1973. $10.00 (Bound/relié)

6 *Energy Resources*, K.J. Laidler, ed., 1973, $10.00

7 *Copernicus*, P. Wyczynski, ed., 1973. Sold by/Vendu par FIDES, $8.00

8 *Waste Recycling and the Environment*, P. Reynolds, ed., 1974, $7.00

9 *Le Rapport Parent, dix ans après*, L.-P. Audet, éd., 1975. Sold by/Vendu par La Maison Bellarmin. $5.00

10 *Frontiers and Limitations of Knowledge/Frontières et limites du savoir*, C. Fortier, éd., 1975. $4.00

11 *The Patterns of Amerindian Identity/Les facettes de l'identité amérindienne*, M.-A. Tremblay, éd., 1976. ISBN 0920064 04 3. Sold by/Vendu par Les Presses de l'université Laval. $13.50

12 *Problems of Development in Atlantic Canada*, S.D. Clark, ed., 1976. ISBN 0920064 01 9. $5.00

13 *Preserving the Canadian Heritage/La préservation du patrimoine canadien*, K.J. Laidler, ed., 1975. ISBN 0920064 00 0. $5.00

14 *The University of the Future* (Summary of discussions)/*L'université de l'avenir* (résumé des discussions), Jan Morgan and K.J. Laidler, eds., 1976 (Free distribution/distribution gratuite)

15 *New Perspectives in Canadian Archaeology/Nouvelles perspectives de l'archéologie canadienne*, A.G. McKay, ed., 1976. ISBN 0920064 06 X. $5.00

16 *Canada and World Food*, W.S. Henderson, ed., 1977. ISBN 0920064 07 8. Sold by/Vendu par Agricultural Institute of Canada. $8.00

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18 *Parasites, Their World and Ours*, A.M. Fallis, ed., 1977. ISBN 0920064 08 6, $6.00

19 *Planetary Atmospheres/Atmosphères des planètes*, A. Vallance Jones, ed., 1977. $6.00

20 *Hermes (The communications Technology Satellite): Its Performance and Applications/Hermès (Le Satellite technologique de télécommunications) : son fonctionnement et ses applications*, I. Paghis, ed., 1978. ISBN 0 920064 12 4, 3 vols. $25.00

21 *Glacier Beds: The Ice-Rock Interface, 1979*, as Vol. 23, No. 89, 1979. Published and sold by/Publié et vendu par International Glaciological Society, Cambridge, CB2 BIER, England. $20.00

22 *The Written Word/Prestige de l'écrit*, A.G. McKay, ed., 1980. ISBN 0920064 14 0. $7.00

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30 *Symbols in Life and Art/Les Symboles dans la vie et dans l'art*, James A. Leith, ed., 1987. McGill-Queen's Press. $35.00

31 *AIDS: A Perspective for Canadians* (Summary Report and Recommendations)/*Le SIDA : L'état de la question au pays* (Rapport de synthèse et recommandations), M. Chrétien, ed., 1988 (first copy free/première copie gratuite, copies additionnelles $4.00 additional copies)

32 *AIDS: A Perspective for Canadians* (Background Papers)/*Le SIDA : L'état de la question au pays* (Documents de travail), M. Chrétien, ed., 1988, $20.00

33 *Diet, Nutrition and Health*, K.K. Carroll, ed. (in publication/doit paraître)

34 *The Family in Crisis: A Population Crisis/Crise de la famille : crise démographique?*, Jacques Légaré, Roderic Beaugot et T.R. Balakrishnan, éds. (in publication/doit paraître)

Other Publications / Autres publications

Présentations

These brochures contain the addresses of introduction by the sponsors of new Fellows in Académie I and the response by these Fellows in which they describe their work or deal with some other topic of their choosing.

Ces brochures réunissent les discours de présentation des nouveaux membres de l'Académie I par leurs parrains et les réponses de ces membres dans lesquelles ils traitent de leur oeuvre ou d'un autre sujet de leur choix.

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Mathematical Reports of the Academy of Science/ *Comptes Rendus Mathématiques* de l'Académie des Sciences :

The Society has lent its patronage to the *Mathematical Reports* compiled by an Editorial Committee drawn from Academy III and published six times annually. The Reports may be obtained by purchase or by exchange. Inquiries should be addressed to the Secretariat.

La Société patronne les *Comptes Rendus Mathématiques* qui sont compilés par un comité d'édition tiré des membres de l'Académie III. La brochure paraît six fois par année et on peut l'acheter ou se la procurer en échange. Prière de vous informer auprès du Secrétariat.

Reports on research carried out by the Society/ *Rapports des recherches* effectuées par la Société :

Acid Deposition in North America, F.K. Hare, ed., 1983. Available from Environment Canada/S'adresser à Environnement Canada, Place Vincent Massey, 351 St. Joseph Blvd., Hull, Québec, K1A 0H3.

Long-range Transport of Airborne Pollutants in North America, F.K. Hare, ed., 1984. Available from Atmospheric Environment Service/S'adresser au Service de l'environnement atmosphérique, 4905 Dufferin, North York, Ontario, M3H 5T4.

Lead in the Canadian Environment: Science and Regulation (Final Report)/Le Plomb dans l'environnement au Canada : science et réglementation (Rapport final), F.K. Hare, ed., 1986. Available from Environment Canada/S'adresser à Environnement Canada.

Lead in Gasoline: A Review of the Canadian Policy Issue/Du Plomb dans l'essence : Étude pour une politique au Canada, F.K. Hare, ed., 1985. Available from Environment Canada/S'adresser à Environnement Canada.

Lead in Gasoline: Alternatives to Lead to Gasoline (Conclusions en français), F.K. Hare, ed., 1986. Available from Environment Canada/S'adresser à Environnement Canada.

Available for the cost of postage and handling from the Society's office unless otherwise indicated. Limited stocks.

Disponibles au bureau de la Société moyennant les frais d'envoi sauf indication contraire. Stocks limités.

The Great Lakes Water Quality Agreement: An Evolving Instrument for Ecosystem Management. O.L. Loucks & H.A. Regier, eds., 1985.

Global Change: The Canadian Opportunity/Transformation du Globe : le défi canadien, Wm. S. Fyfe, ed., 1986.

Human Dimensions of Global Change: The Challenge to the Humanities and the Social Sciences/Les aspects socio-culturelles du changement global : défis pour les sciences humaines et les sciences sociales, D. Braybrooke and Gilles Paquet, eds., 1987.

Selected Papers/Anthologie :

Editorial committees drawn from the membership of the three Academies collaborated in the selection of papers which appeared in the *Proceedings* and *Transactions* of the Society from 1882 to 1975. Alexander G. McKay (General Editor), *Anthologie des*

Mémoires et comptes rendus de la Société royale du Canada – Selected Papers from the Proceedings and Transactions of the Royal Society of Canada. 3 volumes. The three volumes may be purchased separately (Academy I, II, III) or in combination. They may be ordered directly from the publishers, KTO Press (Krauss-Thomson Organization Limited), Millwood, New York.

Des comités d'édition, composés de membres des trois académies, ont choisi des communications qui ont paru dans les *Délibérations* et les *Mémoires* de la Société de 1882 à 1975. Alexander G. McKay (rédacteur principal), ***Anthologie des Mémoires et comptes rendus de la Société royale du Canada – Selected Papers from the Proceedings and Transactions of the Royal Society of Canada.*** 3 tômes. On peut se procurer les trois tômes ensemble ou séparément (Académie I, II, III). Prière d'envoyer la commande directement à KTO Press (Krauss-Thompson Organization Limited), Millwood, New York.

The Royal Society of Canada

The Royal Society of Canada is a national academy whose object is the promotion of learning and research in the arts and sciences. It was founded in 1882 by the Governor General of Canada, the Right Honourable the Marquess of Lorne, and is incorporated by an Act of the Parliament of Canada of 1883.

It is organized into three Academies:

Académie I:	L'Académie des lettres et des sciences humaines de la Société royale du Canada
Academy II:	Academy of Humanities and Social Sciences of the Royal Society of Canada
Academy III:	Academy of Science of the Royal Society of Canada

To fulfil its object it:

- elects distinguished scholars to its membership;
- awards medals and prizes for excellence in learning and research in the arts and sciences;
- organizes an annual meeting at which papers are presented on all aspects of learning and research, and which usually includes a symposium on a topic of concern to all three academies of the Society;
- publishes *Transactions*, *Proceedings* and *Calendar* annually, a Newsletter, *Diversa*, semiannually;
- organizes regional, national, and international symposia on topics of current interest and importance, usually with strong participation from several disciplines;
- publishes the proceedings of symposia when it is appropriate;
- undertakes national and international projects of various kinds for the advancement of learning and research.

La Société royale du Canada

La Société royale du Canada est une académie nationale qui a pour objet de contribuer au développement du savoir et de la recherche dans les arts et les sciences. Fondée en 1882 par le Gouverneur du Canada, le très honorable marquis de Lorne, elle a été constituée par loi du Parlement canadien en 1883.

La Société comprend trois académies :

Académie I:	L'Académie des lettres et des sciences humaines de la Société royale du Canada
Academy II:	Academy of Humanities and Social Sciences of the Royal Society of Canada
Académie III:	L'Académie des sciences de la Société royale du Canada

Les objectifs de la Société sont :

- l'admission par voie d'élection d'érudits distingués;
- l'attribution de médailles et de prix pour récompenser le haut savoir et la recherche dans les arts et les sciences;
- la tenue de Congrès annuels où l'on présente des communications traitant de tous les aspects du savoir et de la recherche, et qui comprennent habituellement un colloque sur un sujet apte à intéresser les trois académies de la Société;
- la publication chaque année des *Mémoires*, des *Délibérations* et de l'*Annuaire* ainsi qu'un bulletin de nouvelles, *Diversa*, deux fois par an;
- la tenue de colloques internationaux, nationaux et régionaux sur les sujets d'actualité importants, ordinairement de caractère interdisciplinaire;
- la publication des comptes rendus de colloques d'intérêt général;
- divers projets d'ordre national et international visant à encourager le savoir et la recherche.

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Edited by Alex Davidson and Michael Dence

Environment is now at the top of the public agenda

This publication edited by staff of the Institute for Research on Public Policy and the Royal Society of Canada and published by the Institute reports on two workshops held in early 1988 to discuss aspects of environmental issues. The first in Hull Quebec was entitled The Cost of Inaction and the second at the University of Waterloo The Brundtland Challenge

The workshop members were drawn from a number of professions and came with wide experience They were much concerned about environmental issues and determined to recommend action on them Accordingly they refused to be constrained by the workshop titles or the fixed agendas and ranged widely over a number of important questions. These included the basic nature of the environmental issue the apparent failure over the past couple of decades of our decision making processes and institutions in attacking the causes - "why have we not done better?" - and the reasons for that and what now must be done They ended with a series of recommendations which set out the results of their best thinking at that time

The report is an important contribution to a better understanding of the environmental issue and of how to attack it

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